2021

Effects of systems on labor optimization in diesel generator service business in Kenya.

Ouma, Erick Zablon Sangoro
Strathmore Business School
Strathmore University

EFFECTS OF SYSTEMS ON LABOR OPTIMIZATION IN DIESEL GENERATOR SERVICE BUSINESS IN KENYA

ERICK ZABLON SANGORO OUMA
MBA/120902/2019

DISSERTATION SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION AT STRATHMORE UNIVERSITY

NOV 2021

DECLARATION

I declare that this work has not been recently and endorsed for the honor of a degree by this or some other university.

No part of this dissertation may be reproduced without the permission of the author and Strathmore University.

Erick Zablon Sangoro Ouma

120902/2019

----------(Signature)

28th Oct 2021

----------(Date)

Approval

The dissertation of Erick Zablon Sangoro Ouma was reviewed and approved for examination By supervisor:

Dr. Joseph Odhiambo Onyango

Senior Lecturer

Strathmore University Business School

----------(Signature)

28th Oct 2021

----------(Date)

ABSTRACT

Labor being a valuable resource in the organization plays a major role in ensuring any organization is profitable. The diesel generator service business in particular employs highly trained engineers who attract relatively high salaries. In order to keep them the organization has to pay them well. The valuable nature of the engineer time brings to fore the need for engineer labor optimization. This study therefore sought to examine labor optimization for diesel generator service business in Kenya**.** Guided by this broad objective, the study sought to examine the role of training, scheduling and technology systems on labor optimization in diesel generator service business in Kenya. This study was grounded by the Dynamic Capability and the Human Capital theories. It adopted a descriptive cross-sectional research design. The study was quantitative in nature and a sample of 224 respondents comprising of staff working with diesel generators was selected based on purposive sampling to respond to questionnaires. Closed-ended questions were used to allow for effortless coding and also precision in data capture. Descriptive statistics was used to evaluate perceptions of labor optimization in the light of scheduling training and technology. The statistical package for social science (SPSS) was vital in the overall analysis to generate more insight. The researcher used regression with inferential statistics to establish relationships between the dependent and independent variables. The results revealed that the respondents were inclined to agree that training had a high influence on labor optimization in their companies and that trained engineers in their organizations take a shorter time on service and repair jobs compared to untrained engineers. A majority of the respondents also agreed that their organizations plan and schedules generator service jobs in advance however some respondents had a contrary opinion. Majority of the respondents agreed that their organizations used technology in the service job planning. The study recommends that for successful training within the organizations, the identification of training needs should be done professionally. This should be done in conjunction with the engineer and the Human Resource personnel ensuring that the training is relevant and is geared towards labor optimization.

Key Words: Labor optimization, Scheduling, Training, Technology, Diesel generator, Power, Engineers.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

DG	Diesel Generator
LU	Labor Utilization
OL	Optimized Labor
UP	Utility Power (Power distributed from the National Grid)
KPLC	Kenya Power and Lighting Company
GDP	Gross Domestic Product
BLS	Bureau of Labor Statistics
US	United States
KBS	Kenya Bureau of Statistics
EPRA	Energy and Petroleum Regulatory Authority
MPS	Motivating Potential Score
KVA	Kilo Volts Amperes
WER	World Economic Ranking
IoT	Internet of Things
ABR	Age Based Replacement
CBM	Condition Based Maintenance
DCT	Dynamic Capability Theory
HCT	Human Capital Theory
SDG	Sustainable Development Goals

DEFINITION OF KEY TERMS

Labor optimization

Labor optimization is the concept of minimizing worker labor costs while maximizing labor preferred outcomes. This can be achieved by adopting optimal scheduling methods alongside other techniques like training and technology (Al-Rawi & Mukherjee, 2019).

Scheduling

The practice of allocating resources to a task with the aim of minimizing labor costs (Al-Rawi & Mukherjee, 2019)

Training

United Nations Economic Commission for Europe (2013), refers to training as skill development involving various activities such as classroom training, job rotation, personal training plans, and collaborations with universities to deliver internal or external training, among other methods.
According to Filippo (1984) training is the addition of knowledge to an employee to perform a specific task. Kulkarni (2013), stated that training is developing skills and attitudes systematically allowing an individual to perform a particular assignment. The applicable definition in this study is by Filippo, (1984).

Technology

This refers to information technology and information systems which includes computer hardware and mobile phones as well as information systems that retrieve process and store information that aid in decision making within an organization (Laudon & Laudon, 2020).

Diesel generator

According to Sechilariu and Locment (2016), a diesel generator converts diesel fuel energy into mechanical energy through internal combustion and finally to electrical energy using an electric generator.

Power

Refers to Electricity produced and delivered to consumers through generation systems, transmission or distributions systems delivered in form of voltage (Brown, 2017).

Engineers

Refers to the service technicians whose task is to service and repair the generator in case of a failure or routine service intervention (Senra et al., 2017).

ACKNOWLEDGEMENTS

I thank the almighty God for the strength courage and energy to complete this dissertation. Second, I would like to appreciate my loving wife Nancy Sangoro for her spiritual support with taking care of family allowing me to focus and remain grounded. I would also like to sincerely thank my supervisor Dr Joseph Odhiambo for his pivotal and sound coaching and to whom the completion of this dissertation is greatly owed. Also greatly appreciate my former manager Surajit Choudhury for his support mentorship and encouragement.

I acknowledge the support of the Diesel generator service companies that were studied allowing me to collect data for the completion of this study. Thanks to Strathmore Business School for the environment that provided a conducive atmosphere for learning and most especially the lecturers for their skill importation. A special appreciation to fellow students that provided insight and context to learning. To my syndicate group; Grace Mogambi, Maureen Kinyanjui, Kate Njoroge, Eunice Mutindi and Vanessa Njunge for their moral support. God bless you all.

DEDICATION

This research work is dedicated to my family for their immense support, love and encouragement throughout the study, and to my son Kristoff Matthew Sangoro who made me realize the power of prayer.

CHAPTER ONE
INTRODUCTION

This chapter describes the background to the study. It postulates the problem statement, outlines the research objectives and questions. It further presents the justification and scope of the study.

1.1 Background to the study

Labor optimization continues to be a key topic of interest, as highlighted in the Sustainable Development Goals (SDG 8). SDG 8 focusses on decent work and economic growth. In particular, it aims to promote sustained economic growth coupled with increased levels of productivity and technological innovation. Over and above job creation, SDG 8 focusses on achieving full, decent and productive employment for all men and women by 2030. 85 million women and 55 million men globally are underutilized in the labor force; hence labor optimization plays a central part in ensuring sustainability for organizations and, by extension, provides decent work, towards achieving full and productive employment (UNDP, 2021).

Labor optimization affects many service industries with the challenge of balancing efficiency and profitability. Kazaz et al., (2008) in their study highlighted that employment constitutes 40% of the costs relating to construction projects and those for electrical and mechanical work were between 40% and 60%. Adebowale and Fapohunda (2015) also raised the argument that human resource represents the most variable production elements, hence required a higher level of focus.

1.1.1 Labor Optimization Systems

Bertalanffy (1968) in his general systems theory defined a system as a set of interrelated elements including categories such as real, conceptual and abstracted systems. Zak (2003) definition of system is a collection of components interacting together. SEBoK (2016) defined a system as a human construct that would assist with better understanding a set of things allowing for the sharing of this information. INCOSE (2015) in their handbook acknowledged that systems are hand-made, created or used to provide products or services in defined environments to benefit users and stakeholders.

In their comprehensive approach to defining the word system, the author borrowed from Bretalanffy (1968) but delved deeper into the ideal definition of a system. They defined a real system as a complex whole which is part of constituent parts or a collection of related interaction components. When referring to real systems the author defined them as two or more elements interacting in a physical space and time giving examples of solar system, climate and weather. The authors definition of a conceptual system was, related informal objects of which if taken together have meaning which cannot be portrayed by the separate components in isolation. In the subsystems of conceptual systems, the author highlighted that systems can also be referred to as abstracted systems that relate to an organizations way of operation (Sillitto et al., 2017).

Manouselis et al., (2011) in their book chapter of recommender systems that facilitate Technology Enhanced Learning aimed at enhancing learning in individuals and organizations. Their system that took a layered approach to technologically enhance learning looked at adopting the learning process to the individual's environment in order to generate the best results from the training. Kozlowski et al., (2001) in their study of integrated embedded training systems also found that by designing synergistic combinations of instructional interventions tailored to the developmental progress of trainees, they could significantly enhance learning performance and adaptability. Thomas (2004) on the other hand did a study of how core non-technical skills impacted on error management predictor systems in the airline industry. They found that scenario-based learning could be achieved with the help of contextual aspects. They further found that these systems could also be used for performance evaluation that could enhance training system design.

In a study of planning and scheduling systems looking at production scheduling systems in a dynamic production environment, the researcher found out that after planning for jobs, random interruptions would interfere with the schedule. This would affect the jobs downstream causing delays and abnormal job scheduling. The recommended solution was a system that allowed for quick dynamic scheduling that could adopt to any situation (Tang et al., 2001). Obegi and Kimutai (2017) in their study of resource scheduling and project performance, highlighted critical aspects of projects with majority of organizations measuring expenditures against budget. They recommend that while managing projects, organizations in Nairobi ought to continue using

schedules with minimal changes to the schedule but also allow room for changes in case of contextual environment changes.

Masabo (2013) in the study of self-service technological systems in banks located in Kenya found that customers derived satisfaction by being able to use self-service technological interfaces.
While there are many other systems that affect labor optimization in the organizations this study narrows down to technology, scheduling and training because the generator service business requires visits to the customers to resolve issues and this greatly involves scheduling. The business also broadly relies on the technical know-how of the engineer and their ability to quickly identify the problem and solve it. Lack of adequate knowledge means extended time in solving the problem and because engineer time is valuable the ability to solve the problem in the shortest time possible would be desirable. The use of technology would help measure and improve the service environment with the possibility of closing the gaps that prevent labor optimization.

1.1.1.1 Training in Optimizing Labor

United Nations Economic Commission for Europe (2013), defines training as skill development that involves a broad range of activities such as classroom training, job rotation, personal training plans, and collaborations with universities to deliver internal or external training, among other methods. E-Learning, which is training over the internet, is also mentioned as a training method that does not necessarily require face to face interaction with the trainers. Filippo (1984) described training as the addition of knowledge to an employee to perform a specific task while Kulkarni (2013), stated that training is developing skills and attitudes systematically allowing an individual to perform a particular assignment. According to Chong (2010), the need for constant training was necessary to manage organizational needs focusing on specific goals and activities that close these skill gaps. Kulkarni (2013), in their research brought in a different perspective on development and learning by stating that developmental learning in a firm ought to focus on values, behaviors, and attitudes more than just the skills to do the job itself. The author went on to elaborate that effective training looks at specific areas of focus that the employee needs for them to be effective at work. Salas et al., (2012) while acknowledging that organizations use billions for annual training of staff in the United States, (US), highlighted that training is also essential in ensuring safety in industries that rely on precision like military and aviation.

Oh (2010) in their study introducing the aspect of cross training and specialization highlighted the importance of training in a firm but raised the fact that beyond a certain number of tasks, cross training would not deliver increased benefit to the organization. Using time study as the method of research, the researcher found that for optimum results in workforce optimization other methods such as job rotation and workforce flexibility would be more effective. Both Kulkarni (2013) and Salas et al. (2012) agree that organizations have the general understanding that investing in an individual helps with getting better results out of them. Salas et al., (2012) however continues to assert that training effectiveness is dependent on design, delivery method to the student. The researcher continues to assert that follow-up is required to ensure skill implementation, and that the organization's competitiveness depends on how much the employees are involved in continuous learning. Training employees also leads to less stress, boosting satisfaction, improving communication within the organization, and also strengthening the organization (Kulkarni, 2013). Since different organizations have different needs from a training perspective, it will be interesting to understand the impact of training systems on the organization's overall labor optimization.

1.1.1.2 Scheduling in Optimizing Labor

According to Yumbe and Norihisa (2019), traditional scheduling methods looked at the engineer's expertise, work shift to be covered, and the nature of the customer request. This type of scheduling technique come with associated problems, including routing the vehicle for the most optimal outcome. The researchers continued to argue that the initial schedule could be interrupted by unforeseen events causing re-scheduling to take place. Voessing and Kunze von Bischhoffshausen (2018) also agreed with the fact that there is need for better scheduling and planning methods to reduce uncertain occurrences. Yumbe and Norihisa (2019) while proposing better operational planning with a focus on scheduling also looked at the staffing models that the organization could use to minimize the total labor cost for each worker, and this would help with equalizing the wok amount for each day and also equalize work volume for each worker. Though this study was on service to IT systems, the researcher highlighted that manual scheduling looks at all static jobs for the month and planning accordingly. In the research they found that by using optimal scheduling methods, the total travel distance can significantly improve using optimal scheduling methods. Optimal scheduling also helped the managers to accommodate new jobs since a disruption to the

initial schedule was expected to have an impact on labor optimization. Oh (2010) in their study on how to improve cycle time with manufacturing found that by introducing job rotation and workforce flexibility it was possible to improve labor utilization significantly, a position also confirmed by Yumbe and Norihisa (2019) in their research which found that dynamic scheduling helped with labor optimization. The extent to which scheduling systems helps optimize labor in diesel generator service business is of great interest to firms aiming to maximize returns on labor as an asset.

1.1.1.3 Technology in Optimizing Labor

Strutynska et al., (2019) argue that technology is the tool firms use to gain competitive advantage and improve internal efficiency. They continued to state that it also helps firms differentiate the firm's business activities in the wake of rising competition. According to the researcher, technology had helped many businesses transform into digital business models, making them react reliably to potential customers responding to dynamic customer needs quickly. Pattichis (2016) in their study of telematics in vehicles found that the technology used helped with improving interaction between the service provider and the customer. This study was however focused on the Finnish vehicle market but poised to provoke industry into the future of technology in service business of automobiles.

Strutynska et al., (2019) in their study stated that there is need to analyze the firm's current business model for the firm to transition into a digital business model enhancing closer relations with suppliers and customers, increasing their product attractiveness and the overall firm position. The researcher continued to assert that by providing modern technologies to employees in the work environment, employees could be more effective at doing their work, directly impacting labor optimization. Other uses of technology in a firm included data mining, digital sensors, resource management, cloud computing, and the use of CRM, telematics, all of which, if applied well in the firm, could significantly improve the firms competitive advantage (Pattichis, 2016 ; Strutynska et al., 2019). Technology also helps with new markets, change in business culture, intelligent analytics, and forecasting. Technology ultimately provides new opportunities for transforming business models in organizations, from linear business models to digital business models.

In their study of mobile app usage in service management, Schmitz et al., (2015), asserted that the use of mobile apps in the mobile phone can help service managers enrich their service offering to the customer. Globally, mobile phone usage has increased significantly, and the inclusion of apps in service delivery allows for the inclusion of the customer to participate in the service event while also making the organization look innovative (Schmitz et al., 2015). In the DG service business, the use of technology may be different aspects; however, the extent to which technology optimizes labor in the diesel generator service business is part of the subject of this study.

1.1.2 Labor Optimization

Due to macro-economic factors such as inflation, government taxation, and political climate, Kenya's labor cost has continued to increase year on year. According to the Kenya Bureau of Statistics (KBS), in 2018, Kenya's inflation rate was at an average of 4.69%, down from 7.99% the previous year. Labor costs that have a close bearing to the country's inflation rate refer to the labor cost needed to produce one unit (Bureau of Labor Statistics, 2018). According to the Kenya Employment Act 2012, Labor costs include housing, medical insurance, and training. These costs vary with different firms. In general, labor costs account for between 23% up to 70% or higher and differ from firm to firm (Huebsch, 2019).

Zhe (2010), in their journal on pay equity and organization efficiency, highlighted that one hotel payroll costs were as high as 60% of the overall organization cost and that the organization's goals were usually to ensure that these costs remain low. Looking at the percentage that labor cost accounts for the overall organization costs, it is clear that an increase in labor costs would put pressure on the organization's profitability since an immediate increase in cost to the customer may not automatically be acceptable. The generator service business in Kenya is monopolistic, and increase in price would mean a drop in quantity demanded; hence total revenue to the firm shrinks. This therefore means that organizations have to optimize labor to maximize profitability while also ensuring engineers are well compensated (Achieng, 2013).

To optimize labor, Bureau of Labor Statistics (2018) argues that increasing hourly compensation for employees increases labor unit costs. The author continues to say that by increasing labor productivity, this in itself balances for any salary increases awarded to an employee. As a result, a

positive impact on the unit cost directly leading to optimized labor. According to Chong (2010), optimizing labor should focus on ensuring that the cost of delivering the product or service remains low and under control. Achieng (2013) took the position that a company can lose staff due to low pay resulting from a focus on reducing service delivery costs. Though this can help with labor optimization, it should be addressed cautiously not to produce unwanted results. This study will specifically focus on the effects of training, scheduling and technology on labor optimization in the diesel generator service business in Kenya.

Organizations have invested in improved and efficient methods to optimize their workforce, focusing on optimal engineer scheduling to maximize profit. To achieve this many types of equipment are fitted with sensors that assist with data mining to allow for better planning driven by equipment condition data. By using improved algorithms that allow for better use of the data it is possible to reduce field service logistical inefficiencies. The internet of things (IOT) has also enhanced relationships between the customer and the service provider tremendously improving the optimization of the service process and labor (Vossing, 2017).

In a study reviewing the fact that labor performance is affected by three significant factors namely quality constraints in doing the work, Jain et al., (2016) brought out the cost element for the overall job and especially the time it took to complete the job. They continued to argue that these factors needed constant monitoring to establish a mechanism for continuous improvement, which ultimately improved profitability. Focusing on how professional firms can meet their target revenues by optimizing labor, Li et al., (2019) asserted that for firms to be successful with optimizing labor, they needed to be strategic and operationally aligned to win in the marketplace. They continued to state that a lack of proper planning for labor and inefficient methods could lead to additional headcount that would increase the organization's overall cost through a contingent workforce. The researcher continued to argue that for labor optimization to be successful, location, labor mix, and labor transformation should align with the organization's overall strategy. Also stated was the need to consider the overall hours required for the job, the total number of people needed to do the job, and the capability level.

1.1.3 Diesel Generator Service Business in Kenya

Kenya generates a significant portion of its power through hydro-based electricity plants and this being the case, the onset of dry seasons leads to a drop in power generation from the hydro electricity generation plants. To ensure equitable distribution of energy, the government embarks on rationing of power to regulate the power distribution to all who needed it. During this time, firms heavily dependent on electricity for their survival invested in diesel generators to ensure continuity in production even with the interruptions (Owusu & Asumadu-Sarkodie, 2016). The data captured by World Bank Surveys (2018) confirms this indicating that, 82.8% of Kenyan firms had experienced electricity outages 3.5 times per month, lasting on average 5.8 hours. The survey also indicated that these outages had led to an average loss of annual sales of 5.4%. Also indicated in the survey is that 65.6% of these firms owned a generator supplying 17.8% of the electric power the firm needed to address the risk of power outages. Owning a generator means that the firms also invested in a service contract to ensure the generator does not fail and that electric power during utility power outages is sustained (Mohamed, 2019).

All machines require service and maintenance at one point or another, which the manufacturer recommends (Sejkorova et al., 2017). This is similar to how vehicle engines require service after clocking a specific number of kilometers. For generators, since they are stationary, this is based on the generators' operational hours, after which the oil and filters have to be changed (Loehlein, 2007). Since this is a specialized job, many organizations in Kenya have opted to outsource this service to generator service companies that send their engineers to perform the service at the customer premises. They charge a fee while offering this service. Locally Kingori (2013), in the study of strategic outsourcing at Airtel Kenya, highlighted this, giving reasons why companies choose to outsource, of which minimizing risk to the organization was part of it. The cost of running a firm on generator power can be relatively high. For this reason, the generator service providers may not be able to recover workforce costs that continue on an upward trend year on year from customers. The organization has to optimize resources to remain profitable.

The firms in the business of providing service to diesel generators have to grapple with various challenges including identifying the most optimum way to sustain profitability while also offering

the best service support to their clients. Madziga et al., (2018) discuss and highlight the cost implication of diesel generators in a hybrid environment bringing to fore from the study that the cost of running the diesel generator is relatively high. Firms that need electric power above 15Kva, more often than not chose to use diesel-powered generators, since diesel fuel is considerably cheaper than most other fuels and among other benefits which include the less flammable nature of diesel compared to petrol for storage purposes. According to the Energy and Petroleum Regulatory Authority (EPRA,2019), diesel retailed at 94.82 Kenya shillings per liter while super petrol retailed at 116.79 Kenya shillings a liter.

The Diesel Generators (DG), also known as the Diesel Genset, is a diesel engine with an electric Genset, often an alternator, to generate electrical energy. A diesel generator converts diesel fuel energy into mechanical energy through internal combustion producing electrical power using an electric generator (Sechilariu & Locment, 2016). For the DG to be efficient, regular service is required to achieve optimal performance. Service includes both preventative and corrective maintenance (Fehr, 2017). According to Fehr (2017), corrective maintenance is a less often activity performed in the form of visual inspection in DG so that any potential fault is fixed before it results in operational failure. The author also clarifies that preventative maintenance, on the other hand, is performed at regular intervals to minimize the failure rate of the DG.

The diesel generator service business in Kenya has several players but for the sake of this study the focus is on the companies that have a relatively long history servicing diesel generators. These players in the diesel generator service business in Kenya include; 1) Car & General limited and 2) Cummins C&G Ltd both offering service to Cummins diesel generators, 3) Simba Corporation which offers service to Aksa diesel generators, 4) Blackwood Hodge offering service to FG Wilson diesel generators, 5) Mantac Group that offers service to Caterpillar and Perkins diesel generators 6) Achelis Kenya that offers service to Pramac Diesel Generators, 7) Ryce Motors offering service to SDMO diesel generators, 8) Davies & Shirtliff Group offering service to Dayliff diesel generators (Kenya Bureau of Statistics, 2020).

1.2 Problem Statement

Kenya being one of the countries with very high cost of labor, has more often than not forced companies to embrace tactics and business models that help with labour optimisation. In essence

it may not be possible to recover these costs by passing them on to the customer (Golub et al., 2018). As highlighted by Kazaz et al., (2008) and Zhe (2010) labor costs are considered to take up a significant amount of the costs in an organisation and hence for companies to remain competitive, they have to balance between optimizing the existing workforce and getting the most out of them. With optimized labor, firms have better returns to shareholders arising from improved resource mobilisation delivering better and timely service to customers (Kulkarni, 2013). Also optimized labor allows for better engagement of the workforce, allowing for better communication within the organisation as well as improved productivity (Kulkarni, 2013; Heshmati & Rashidghalam, 2016).

Optimized labor helps with ensuring optimal usage of complementary resources such as vehicles that can increase costs with reduced efficiency. This can manifest in the form of several trips to the customer before resolving a genset problem. Also worth noting is that optimized labor helps with differentiation in the market for the organisation which leads to competitive advantage (Salas et al., 2012). Without optimized labor firms run the risk of having their costs running up and out of control, (Zhe, 2010). They may also have to get a contingent workforce to fill the gaps created by inefficient methods (Li et al., 2019).

There are various challenges to optimizing labor that include lack of knowledge in the use of self-service technologies that help organisations to measure the right metrics and to engage with the customers accordingly (Schmitz et al., 2016). Karibasamma and Alur (2018) in their study highlighted the challenges with labor organisations in India that included the ability to respond to market demand in a dynamic way. Because of the legal restrictions, the companies resorted to having contract employees only as a way to provide them with flexibility in responding to dynamic labor requirements as a response to market dynamics. Another challenge is the shortage of adequate trained workforce able to complete tasks within the standard repair times as stipulated by the manufacturer (Salas et al., 2012). Because of poor infrastructure, engineers have to spend most of their available time travelling and navigating through the city traffic to get to the equipment location of which can improve through better scheduling techniques (Yumbe & Norihisa, 2019).

The diesel generator service business's success heavily depends on the firms' ability to dynamically work with their internal resources, including the labor force, to meet customer needs. The study by Pöppelbuß et al., (2011) proposed a new framework in service innovation in Germany, emphasized this in detail using the dynamic capability theory as its grounding theory. The researcher asserted that the service business's continuous innovation is crucial to the success of the business. The study focused on the need to sense the firm's innovation needs seizing the opportunities and then transforming them to meet the customer requirements. The researcher also raised some questions for additional research. These included the need to focus on evaluating specific activities described in the study, of which one of them was learning and adapting. This research on the effects of training scheduling and technology on the diesel generator service business in Kenya seeks to add knowledge to the highlighted study gap. Adebowale and Fapohunda (2015), in their study conducted in western cape and Gauteng south Africa, also highlighted that labor remains a significant factor requiring closer monitoring and optimal deployment in a dynamic environment, such as the diesel generator service environment in Kenya.

Gelb et al., (2017) in their study concluded that industrial labor costs and labor productivity costs in Africa are far higher than in other comparative countries across the world. The comparison is between the African nations and Bangladesh which is a key manufacturing country. The study looked at countries with similar World Economic Rankings (WER). Of these countries, Bangladesh seemed to have the labor cost almost similar to its Gross Domestic Product (GDP) per capita while the other African nations showed costs almost twice as much as their (GDP) per capita. Also, to be noted is the capital costs per worker which is very high in the African nations as compared to Bangladesh with Kenya being at $9775.45 per worker. This among other findings in their study led the researchers to conclude that African nations Including Kenya still have a very high labor cost per worker as well as capital costs per worker relative to other manufacturing nations like Bangladesh (Gelb et al., 2017)

The fundamental problem this study seeks to address is in light of the cost of labor rising year on year. The question being, can a diesel generator service business in Kenya remain profitable by optimizing the labor resource. Paying a lower wage to the engineers would mean they leave the

organization. The highly paid engineer labor necessitates optimal use of engineer time by the organization. The frequent change in technology in the diesel generators imposes the need for training to close the skill gap. The generator service business also requires that the engineers travel by road to customer locations and they may come across traffic jams and other related obstacles. Without optimal scheduling methods, labor optimization would be impacted. Through technology, many service organizations are able to easily track improvement and make the necessary corrections to their labor utilization metrics without which it would be a difficult task. The role of technology, training and scheduling can therefore not be ignored and hence are considered as variables in this study. There however exists other variables that affect labor optimization but the researcher will only dwell on the above three variables because of their close relationship to diesel generator service business in Kenya.

There is a gap in studies specifically looking at labour systems in diesel generator service business in Kenya. The gap also extends to the fact that there are few studies on the combined relationship between scheduling, training and technology labour optimisation systems. It is therefore necessary to study the effect of systems on labour optimisation in the diesel generator service business in Kenya.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of the study was to establish the effects of systems on labor optimization in diesel generator service business in Kenya.

1.3.2 Specific Objectives

i. To establish the effect of training on labor optimization in diesel generator service business in Kenya.
ii. To establish the effect of scheduling on labor optimization in diesel generator service business in Kenya.
iii. To establish the effect of technology on labor optimization in diesel generator service business in Kenya.

1.4 Research Questions

i. What is the effect of training on labor optimization in diesel generator service business in Kenya?
ii. What is the effect of scheduling on labor optimization in diesel generator service business in Kenya?
iii. What is the effect of technology on labor optimization in diesel generator service business in Kenya?

1.7 Scope of The Study

The scope of the study was limited to evaluating the effects of training, scheduling and technology in optimizing labor in the diesel generator service business in Kenya. The study was restricted to the city of Nairobi since all the companies had their corporate headquarters in Nairobi and most of their employees and generator service business was centered in Nairobi. The sample size was based on the organizations in the diesel generator service business in Kenya and have been in the industry for more than 20 years as they would have richness of knowledge in the business. This is a convenient scope in light of the time constraints and the limited financial resources for data collection. The projected time frame was three months in order to collect the required data.

1.8 Significance of the Study

With the increasing competition in the business environment, the organisation's strategic internal alignment is necessary. This study will help craft winning policies and assist with the ideal resource prioritisation within the service business environment. The study will also help achieve the most optimal workforce utilisation levels while helping organisations to set benchmarks of ideal operational service structures for a successful service business. This study will also benefit service companies that would like to borrow and adapt the model to their operations to achieve optimal business results.

The service Manager continues to be under pressure with every decision they make on the individuals and team's staffing levels. They are also under pressure with scheduling decisions to complete tasks effectively and which technology to use and to what extent. This study will help

the service managers improve their decision making on such situations to increase efficiency within the teams and ultimately realise a more significant return on the labor invested.

In the wake of the heightened need for efficiency in the workplace driven by the need to remain competitive, this study will help scholars advance studies to understand further factors that affect labor optimisation in the context of various industries. The optimisation of labor in the business atmosphere is still a complex phenomenon and requires extensive research to understand various service industries' impact.

This study looks at how labor is optimized in the diesel generator service business. Therefore, it will help improve Gross Domestic Product (GDP) per capita, considering the companies in related fields will yield higher productivity levels allowing for improved GDP levels. It will also help the policymakers on the key areas that would help improve the country's workforce work environment, considering that in Kenya, the government plays a significant role in ensuring businesses enjoy security, tax benefits, and other related benefits to achieve higher productivity levels.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoretical review, empirical review, and conceptual framework of the study. The theoretical review delved into theories anchoring the study demonstrating how these relate to the study. The empirical review supports the existing links between training scheduling and technology on labor optimisation in relation to the methods adopted by different organisations highlighting the gaps to be bridged. The conceptual framework graphically presents the effects of training scheduling and technology on labor optimisation.

2.2 Theoretical Framework

The study was anchored on the Dynamic Capabilities Theory (DCT) and Human Capital Theory (HCT). Dynamic capabilities theory focusses on the firm's ability to purposefully adapt the organizational resource base towards sustained superior performance over time. Human Capital theory emphasizes on how increased acquisition of knowledge increases productivity and efficiency of a workforce.

2.2.1 Dynamic Capabilities Theory

Teece advanced dynamic capabilities theory to address some of the shortcomings of the Resource-based view theory that preceded it. The theory, as advanced, aimed at enabling firms to integrate seize and reconfigure internal capabilities and resources adapting to the ever-changing business environment. The study at hand on the effects of training scheduling and technology on labor optimization draws significantly from the dynamic capability theory. This is because it seeks to understand the optimal configuration of the variables training, scheduling and technology that constitute the service organization capabilities and resources to achieve optimized service labor (Bleady et al., 2018).

Teece et al., (1997) defined Dynamic capability as the organization's ability to reconfigure itself to adapt to changing internal and external business environment aligning to customer's needs. Teece (2019) in the study, stated that the dynamic capability theory focusses on how firms can survive in the long run using creative ways of resource deployment to manage threats and

competition. The author stated that a firm's ordinary capability includes cost control, quality control, and labor productivity measures, which are considered easy to imitate. Zahra et al., (2006) stated that dynamic capabilities theory focuses on the organization's strategic transformation within the prevailing environmental condition. On the other hand, Winter (2003) argued that dynamic capabilities theory only focused on helping the organization to survive the current situations with little focus on future strategic sustainability.

Wilden et al., (2013) in their argument held the position that though dynamic capabilities theory, adopting firms were presumed to be relatively more robust performing, there was no assurance that the resultant performance equated to the firm's expected performance. The author also argued that dynamic capability theory draws from the contingency theory, particularly regarding both the internal and the external context to deliver desired outcomes. In their conceptual study, Andreeva and Ritala (2016) asserted that dynamic capability falls into two main categories: domain-specific capabilities and generic dynamic capabilities. While advancing their opinion, they stated that these dynamic capabilities were particularly idiosyncratic making them difficult to imitate. Eisenhardt and Martin (2000) stated that dynamic capability in itself did not boost performance in an organization, but the firm's ability to configure their internal resources was the differentiating factor. Zhou et al., (2019) stated that the dynamic nature of the business landscape and the rapid technology changes had forced many companies to tap into their dynamic capability as a matter of necessity and a key to survival.

According to Zhou et al., (2019) and Teece (2019), dynamic capability comprises of (1) sensing which is the ability of the firm to identify opportunities in the market, (2) Integration which refers to the organization's ability to harness the various internal aspects of the organization as well as internal and external networking (3) Configuration which is the firm's ability to define a sustainable pathway for itself whenever the need arises to overcome challenges in the market. Zhou et al., (2019) in their study concluded that for dynamic capability theory to work, technological innovation had the most significant impact. Teece (2019) on the other hand argued that for dynamic capability theory to work successfully, the firm needed to close the existing capability gaps that came up, and these could be closed through two ways, one of them being

through learning and the second through transforming and that transformation was found to be heavily dependent on the leadership of the organization.

Zhou et al., (2019) in their study of the mediating role of innovation in dynamic capability and organization performance asserted that the mechanism associated with getting an organization performance to improve using dynamic capability was still unclear. They continued to state that the mediating factor was innovation. Teece (2019) while advancing their argument on dynamic capability theory also agreed with this viewpoint by stating that resources in an organization which comprise of the employee skills, the collective skills of the entire organization including their internal offerings they are able to deploy, ought to be configured in an innovative way. The author asserted that the coordination of these resources remained a significant factor to consider in order to optimize performance.

According to Teece (2019), capabilities of an organization refers to how the organization combines and exploits their internal resources, while also learning to adapt to market changes. The author presented the argument that dynamic capability resided with the top management that could adapt the organization to changing business environment. This capability resided in the organization values and culture which allowed it to adopt to new ways and models of doing business when the need arose. Gong and Shang (2018) looking at it from a different perspective in their study found that timing of the capability configuration in the routinization process of the firm was also a significant factor to consider. They proposed that dynamic capabilities that aim to reconfigure ordinary capabilities ought to align through repetitive routines that embed the routines. Presenting their argument, they stated that routinization of processes in a firm may have an impact on the organization's ability to adapt to the market environment as proposed in the dynamic capability theory. They continued to state that it was still not clear the permissible extent to which firms could routinise processes, but also stated that this remained to be a debate in the backdrop of dynamic capabilities theory. They argued that routinization was a fundamental building block element towards a sustainable competitive advantage for an organization stating that it raised a conflict with dynamic capability theory, which also claimed to do the same thing in a different way.

Dynamic capability emphasizes on the intangible assets of the organization, including the organization knowhow, which is scarce and difficult to imitate. The author stated that Dynamic capabilities theory invests in discovery, making a case for the generation of new knowledge and allowing the organization to evolve by learning (Teece, 2019). Pisano (2017), in their concluding arguments asserted that dynamic capabilities theory looked at the firm's choices about how to deploy their internal resources for optimal performance with little consideration of the cost implications. The researcher continued to state that firms would ideally make choices at the margin and this therefore meant that a deeper exploitation of existing resources and capabilities as opposed to broadening capabilities that would be financially prohibitive is preferable. They also asserted that the question the firms ought to pose internally was how the organization could be adaptable to the market environment as opposed to what capabilities the firm should create to remain competitive.

Dynamic capability in the firm's performance is not significant on its own; however, coupled with technological innovation, it is made significant. A significant relationship similarly was found when testing the relationship between reconfiguration and technological innovation. The findings raised the fact that dynamic capability in itself may not deliver the necessary performance needed by the organization but requires mediating factors such as technological innovation. This study was quantitative, and data was collected using standard questionnaires (Zhou et al., 2019).

This theory fits well with the study and underpins both the technological and scheduling systems. This is because for the organisation to optimise labour the ability to optimise the scheduling of engineers is in how well they can quickly adopt themselves to the environment and this is in line with Dynamic capability. In essence schedules may need to be disrupted and reorganised for optimal usage of time. For technology to optimise labour they have to be dynamically integrated and applied to allow for useful information that would enable the organisation to correct itself towards an optimised labour environment. Through technology the turnaround time on jobs can be determined and the specific areas of improvement addressed.

2.2.2 Human Capital Theory

The human capital theory was advanced by Beker (1963) and was based on the principle that humans and society derive value in investing in people. Though human capital included health and nutrition, education emerged as the most critical human capital investment (Sweetland, 1996). Nemeth (2017) asserted that there is still no single model around this theory that fits in organizations with a unified understanding; however, it helps determine human capital's true worth. Marginson (2019) highlighted that education drives marginal productivity. This study on the effect of systems on labor optimization in the diesel generator service business draws on this theory to explain the study's training aspect and its significant role in optimizing labor. The theory that looks at education as a critical investment is vital in ensuring that no time is wasted because of a lack of knowledge on the service work to be carried out on the Genset, optimizing labor.

It is possible to determine human capital through productive abilities, including education, qualifications, participation in training and work experience (Schulz et al., 2013). The researcher continued to elaborate that there is a new view of human capital, which requires employees' perfect motivation, which leads to Self-determination theory and that those who are likely to learn and put special knowledge into their organization are the highly motivated ones. Hendarmin and Kartika (2019), in their conclusion, stated that education levels and investment variables had a positive effect on the level of production in Kalimantan provinces. The researcher continued to recommend that human capital development needed to remain a strategy for future successful development plans focusing on human capital development. Even though human capital theory has explained positive aspects of human capital in organizations, Marginson (2019) highlighted some of the limitations of this theory, stating that human capital theory does not explain how education augments productivity.

This theory is relevant for the study and underpins the training variable. Unlike technology and scheduling which can be adopted quickly to overcome obstacles optimizing labor, training takes longer to implement. In order for an organization to realize the benefits of training in optimized labor the training system needs to be crafted and adopted with foresight to ensure the engineers are equipped well in advance since training takes a significant amount of time to apply compared to technology and scheduling.

2.3 Empirical Review

2.3.1 Training and Labor Optimization

Benefits of training in an organization are emphasized by Caldarola et al., (2018) as they state that training while on the job created concrete competencies tailored to each employee which as a result led to better performance on the job. In their study centered on ways in which the work environment can be transformed into a smart environment to enhance learning, the author projected the argument that by using virtual learning environments, it was possible to tailor training that was specific to each employee needs based on prior information. The study found that training and development could be achieved without lessening production. Sapri and Pitt (2005) also agreed with this highlighting the possibility of having a tailored training solution to the employee on the job as a benefit to delivering superior performance. They however held the opinion that the success in delivering quality training lied in the organizations ability to identify specific needs accurately to drive behavior change.

While aiming at improving workforce capacity in particular, the idea of cross training was presented while also looking at inventory levels which played a major role in the service event. They were able to solve the problem of having an optimal inventory level that would facilitate an optimized workforce in the backdrop of a cross-trained workforce that is capable of flexible deployment. In the study of how a multi skilled workforce can be optimized, they focused on how this type of workforce could be configured to achieve high asset availability using effective service strategies. Also highlighted in the study was the fact that through cross training, it was possible to achieve high labor utilization through reduced repair times. The author however stated that the process of identifying the rights skills to include in the cross-training program remained to be a huge challenge (Turan et al., 2020).

Focusing to understand how workforce training affects the organizations overall performance, a study focused on selected firms in Anambra State of Nigeria was conducted by Nwankwo (2018). With data captured using random sampling, the conclusion highlighted the fact that there was need for expert involvement in the choice of training within the organization. This was with the aim of ensuring that the training done is relevant and that resources were not wasted with non-meaningful

training programs. The author also concluded while emphasizing the role of training as a key means to optimizing organizational resources, that training should be in line with the organization needs and the resultant technique to be used in the training should be targeted at yielding the right results.

In the study of effects of training on workforce performance, Nassazi (2013) highlighted the importance of organizations to employ a workforce with the capability to adopt and be trained so as to adjust to the ever-changing business landscape. Also highlighted in the study was the fact that it is only through training that the organization was able to develop its own intellectual property. Their findings suggested that training and development had an impact on how the employee was able to perform at work. Zikos et al., (2016) also agreed with this and stated that the development of human resources was key to the development of organization performance. The study by Nassazi (2013) was limited to telecommunication companies in Uganda and purposive sampling was used.

According to Mwangi (2014) in a study of maintenance in power production stations in Kenya inadequate training of technical personnel was highlighted as one of the major challenges to maintenance contributing to the in optimal performance of the work force. The study also highlighted that the top management played a major role in ensuring that personnel had the right tools for the job.

2.3.3 Scheduling and Labor Optimization

A study by Senra et al., (2017) on supporting maintenance scheduling emphasized the fact that service maintenance required the engineer, the spare parts and the equipment, all of which had to be available for a successful service event. If any of these elements were not well synchronized with the others, then it would lead to inefficiencies around the engineer labor utilization. They continued to argue that based on equipment importance to the business and availability schedule, the service manager proceeded to allocate the jobs to the engineers. To achieve optimum results the algorithm needed to be applied dynamically enabling the organization to respond to the customer's needs in the market with agility. They concluded that by using the algorithm that helped with prioritizing accounting for equipment availability, process time for service event, the spare

parts required among other key items, it was possible to show increased effectiveness in optimizing operations including workforce time. Irawan et al., (2017) in their study also highlighted that for service maintenance costs to remain low, there was a need to optimize maintenance schedules. In their study of service to wind firms, they highlighted that dynamic response to scheduling was required taking into consideration the weather, resource availability, engineer capacity and specific skill type.

In their study focused on optimizing the mobile field workforce, Starkey et al., (2016) highlighted various challenges with achieving workforce optimization in dynamic environments. These included data from sensors that may have been incomplete or unclear, the inability to deploy the required skills for the job due to sickness, travel time estimates being incorrect from a route planning perspective and incorrect estimates of job completion times. In the study using fuzzy system logic systems the challenges could be managed. The study looked at optimizing the work area with the aim of optimizing the workforce. The study concluded that the application of these logic systems to specific mobile workforce teams resulted in increased utilization of the workforce and reduction in costs.

Highlighting the role of decision support tools for workforce planning, Simeunović et al., (2017) conducted a study on how to improve scheduling of workforce using artificial neutral networks models. They projected the view that through optimal scheduling it is possible to achieve desirable workforce utilization. Methods such as the science of predicting the needs of products and services using various relevant algorithms were portrayed as vital for improved efficiency. The study which was based on historical data performed experiments to arrive at their conclusion. While looking at the dynamic nature of the business environment the author highlighted the need to have quick response to customer needs in order to improve the quality-of-service delivery. Also emphasized was the need to have flexible resources that can adopt to situations as a key element to successful scheduling to achieve optimal service response levels which ultimately would ensure optimal use of workforce. In their conclusion it was established that with the use of prediction systems, efficiency of scheduling was achieved. They also highlighted that the model which uses Artificial Neutral Networks (ANN) was a useful system that could be used in service and production work systems to optimize workforce utilization optimizing labor.

Koochaki et al., (2013) in their study comparing benefits of Conditional Based Maintenance (CBM) associated with just in time maintenance practices and Age based Replacement (ABR) associated with change of components after a fixed period of time. In their conclusion it was found that CBM would not be able to allow for grouping of events that would have the effect of reduced cost when scheduling resources. ABR method presented greater advantages compared to CBM method. On the other hand, the CBM method presented a more efficient environment if looked at from the time between services. Overall ABR was seen to offer smoother service intervals allowing for better scheduling and planning and this had the potential of supporting managers with making better service scheduling decisions.

A study on how to reduce cycle time with ergonomic labor force scheduling Introduced Job rotation as a key element in the workforce scheduling domain. The study main objective was to look at the optimal level between the worker and the specific work they were required to do from an ergonomic perspective. The study derived a method that would be useable in a daily planning environment to assist managers with scheduling decisions. While looking at an assembly line that works twenty-four hours seven days a week and testing the impact of job rotation in this environment with particular attention on ergonomics, the study found out that with optimal scheduling allowing for job rotation, efficiency was improved as a result of prevention of ergonomically related disorders that would arise with non-job rotation environments. By determining which job is to be done by which worker on a particular day it was possible to improve efficiency and by extension reduce overreliance on specific skillsets within the teams Moussavi et al. (2016).

In a study of maintenance in the power production stations in Kenya the study found that preventive maintenance was used most of the time in most stations, followed by scheduled maintenance. The study also highlighted challenges with delayed spare parts delivery and cumbersome process in obtaining them as the biggest challenge with maintenance at the substations (Mwangi, 2014).

2.3.4 Technology and Labor Optimization

Looking at remote monitoring technology applied in servitised strategies Grubic and Jennions (2018) in their research highlighted the benefits of remote monitoring technology and its relationship with servitised environment. The study looked at the aspects of remote monitoring that complemented the service environment and those that restrained the ease of service delivery. The perspective drawn by the author lends credibility to the fact that the use of remote monitoring technology if applied appropriately to the service environment could improve the management of the team and ultimately the optimization of the workforce. Highlighted in the study relating specifically to use of technology in communicating with equipment in the field to reveal the equipment's performance and condition, they argued that by having a remote view of the equipment performance, there was a possibility to take action based on information captured from the equipment. Advancing their point of view, they stated that the information captured is vital since traditional troubleshooting methods required a physical visit to the equipment to identify the problem after which a second visit to repair was necessary. A second visit to repair was considered an unnecessary trip cost that could have easily been avoided by gathering the right information remotely and resolving the problem with one visit. The author asserts that the ability to have a remote assessment of equipment allowed for improved equipment availability and efficiency, considering that the repair event would be timely and specific, avoiding unnecessary delays in repair. Conversely, the author highlighted that there was limited research on remote monitoring from a management perspective hence an area for further future research.

Li et al., (2019) while looking at this from a dynamic capability perspective, clearly projected that the use of technology in this way would have a positive impact on how the human resources or even the required number of engineers in a team are determined. As a result, this would lead to a more optimal approach to workforce planning. However, according to the researcher there were some drawbacks in this technology in that for it to be effective, the equipment type played a significant role in determining the type of information transferable through the remote channel. Manual engines, for example, would give less in the way of information transferred than electronic engines. This highlighted how important it was for the organization to ensure the application of this technology to improve efficiency was highly dependent on the appropriate application of associated technological media (Grubic & Jennions, 2018).

Looking at technology from a connectivity perspective, Breidbach et al., (2013) with a study of technical connectivity in service business highlighted two aspects of connectivity. These included hyperconnectivity which related to having too much connectivity between individuals through various means including mobile phones, the internet, and other technological means and hypoconnectivity, which related to the lack of adequate connectivity. While appreciating the increased presence of technology use in the organization environment to manage the field workforce, the author highlighted the various aspects of connectivity and their role in optimizing the workforce. According to the researcher, hyperconnectivity was undesirable for optimal performance of the workforce as it interfered with performance in the form of interruptions to the worker as they performed their task. Even though the connectivity provided for information exchange, the lack of control of how much information to disseminate resulted in a negative impact. Conversely, hypoconnectivity which relates to reduced connectivity due to limited or low connectivity between individuals in an organization was undesirable. Even though the use of technology was presumed to improve performance, some of these variations were undesirable as they had the potential of generating negative results hence the need for service organizations to adopt them with caution. The researcher also presents the argument that the difficulty with delivering the required service levels arising from low connectivity, known as hypo connectivity, could be a hinderance to efficiency. Looking at both scenarios, the researcher argued that organizations needed to adopt technology well aware of these challenges and accordingly apply them in line with their unique situation to yield positive results. Worth noting was that the internal organization's context was critical in applying these technologies to have optimal labor and workforce utilization.

Using the Maynard Operation Sequence Technique (MOST), it was possible to achieve greater accuracy with repetitive and non-repetitive work. Jain et al., (2016) performed a study of optimization of labor productivity using work measurement techniques specifically looking at (MOST). The study helped establish the standard time required to complete a task to eliminate fatigue on workers. The study also had the potential of identifying non-value add time allocated to jobs. The author also highlighted the need for measurement and highlighted that different organizations have different methods of capturing time taken by workers and that there were

sophisticated computer systems that could help with tracking efficiency and labor optimization so as to capture this. The researcher who used time study, activity sampling, among other methods to capture the data elaborated that ideally, the lower the amount of time required to complete the activity, the higher the labor productivity.

2.6 Research Gaps

Table 2.1: Research Gaps

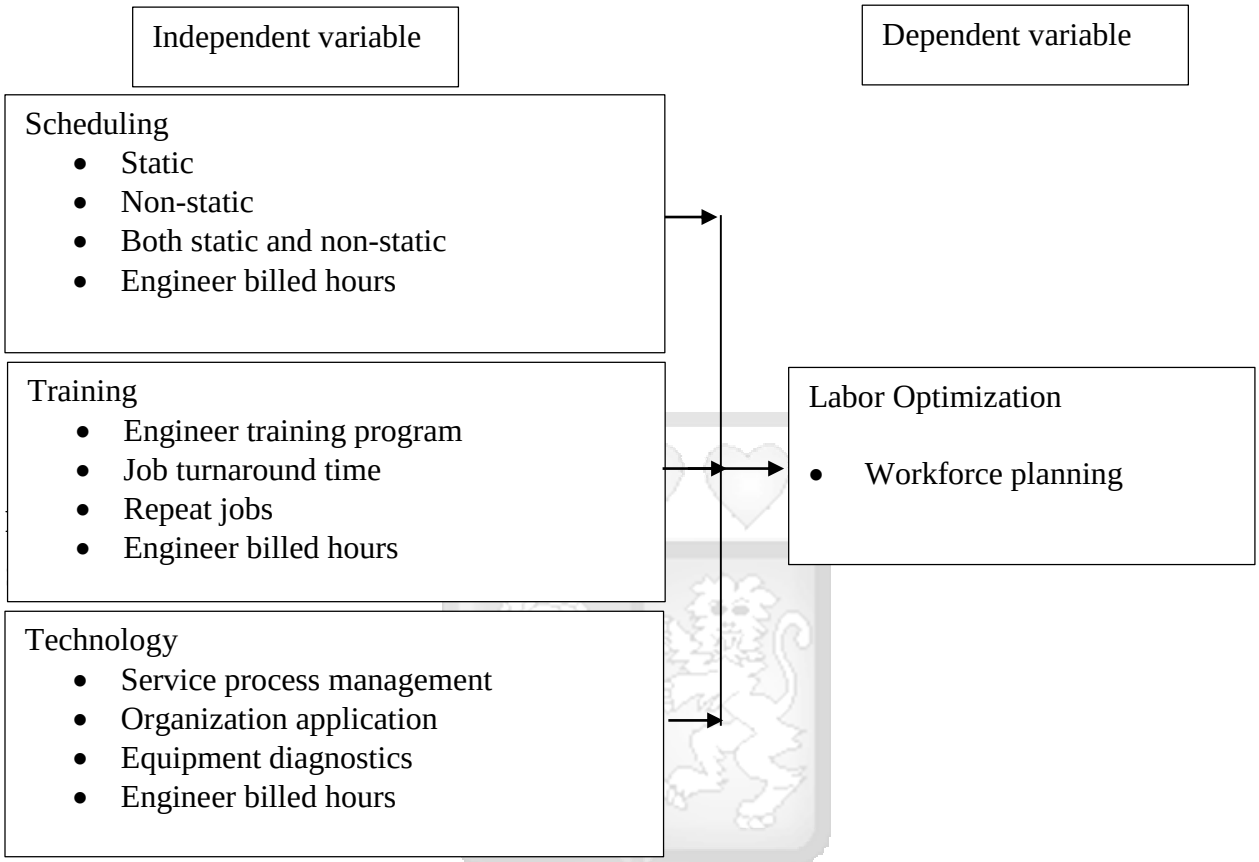
Author	Title	Findings	Research Gap
Caldarola et al. (2018)	Enhancing the Workforce Skills and Competences by Leveraging a Human-Centered Knowledge-Based System in the Rise of Industry 4.0.	The paper demonstrates how the framed technologies helped with implementing the user-centered environment within the factory	The study was centered in a factory and engineers did not have to travel around to complete tasks.
Zikos et al. (2016)	Human-Resources Optimization & Re-Adaptation Modelling in Enterprises.	Labor was optimized through probabilistic perspective which assisted in decision making on the resource assignment.	The study did not look at training alongside scheduling and technology.
Starkey et al. (2016)	A multi-objective genetic type-2 fuzzy logic-based system for mobile field workforce area optimization.	By using fuzzy logic systems, they realized improved labor optimization for a mobile field workforce	Study was not done locally in Kenya and was also for a different type of industry.

Simeunović et al. (2017)	Improving workforce scheduling using artificial neural networks model. Advances in Production Engineering & Management,	Optimization of labor was achieved using the prediction systems of scheduling.	The study was not curried out in Kenya considering the different nature of obstacles.
Koochaki et al. (2013)	The influence of condition-based maintenance on workforce planning and maintenance scheduling.	Age-Based Replacement (ABR) was preferred over Conditional Based Maintenance (CBM) methods of which if applied would improve labor optimization	The system relied on sensors to the equipment which is not the case with Diesel generators hence the support systems is different in Kenya.
Breidbach et al. (2013)	Connectivity in service systems: Does technology-enablement impact the ability of a service system to co-create value?	Through mobile remote monitoring's systems, they were able to capture information and avoid unnecessary troubleshooting trips to the equipment.	The study was not specific to the Diesel generator service industry.

2.5. Conceptual Framework

The hypothesis in this study is that the extent to which labour is optimized will ultimately affect the organisations overall success and profitability. Training, efficient scheduling and technology systems are some of the options at the disposal of organisations to optimize labor. If used well, they will likely improve labour optimization.

Figure 2.1: Conceptual framework



Source: Researcher (2021)

According to Figure 2.1, the dependent variable is Labor Optimization (LO) while the independent variables are broadly Training, Scheduling and Technology. To achieve optimal labor utilization, the independent variables will require the right set of configurations to ensure the engineer can have a shorter work turnaround time in order to optimize labor. For managers to be efficient at optimizing Diesel Generator (DG) service labor, scheduling of field service interventions need to be through the most convenient routes. The choice of engineer also ought to consider their skill levels and internal training which would assist with ensuring the right set of skills for the job to be done. Employment of technology in the running of the service business is essential being that engines now are fitted with electronic diagnostics to troubleshoot cutting down the fault-finding time. Ultimately the use of technology to deliver a quicker service is expected to have a positive impact on labor optimization. Employing dynamic capability methods, the service manager can

make prudent decisions deploying resources in the most efficient configuration bearing in mind the internal capabilities of the organization.

Table 2.2: Operationalization of Variables

Variable	Conceptual definition	Indicators	Measure
Independent Variable	Scheduling- relates to the methods used by the organization to schedule the engineer for optimal labor utilization	• Static scheduling • Non-Static job Scheduling • Both static and non-Static scheduling method • Scheduling enables engineers bill 100% of their work hours.	Static scheduling method 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent Non-static job scheduling method 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent Both static and non-static scheduling method 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
	Training- refers to the level of training given to the engineer to improve performance	• Training activity exists in the organization	Organization trains its technicians. 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent

		• Job turnaround time by trained engineers is faster.	Trained engineers complete work faster 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
		• Trained engineers get the job done right first time.	Trained engineers get the job done right first time. 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
		• Trained engineers bill 100% of their work hours.	Trained Engineers bill 100% of their work hours. 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
	Technology- this is the various technology applied by the organization to effectively manage the service event	• Technology is used in service process management	Technology is used in the service process management. 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
		• Technology is used to plan service events	Technology is used to plan service events

		• Technology is used to diagnose equipment failures	1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent Technology is used to diagnose equipment failures. 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
		• Technology enables 100% of engineer work hours to be billed	Technology enables 100% of engineer work hours to be billed 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
Dependent Variable	Labor Optimization- this refers to the percentage measure of how much of the labor hours the company pays for the engineer is recovered when	• Labor optimization is measured • Labor optimization is used in engineer	Labor optimization is measured within the organization 1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent Labor optimization informs engineers workforce planning

	billing out to the customer	workforce Capacity planning	
			1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
		• To what extent is 100% billing of engineer work hours dependent on Engineer training, Job scheduling, Use of technology	
			100% billing of engineer work hours is due to engineer training
			1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
			100% billing of engineer work hours is due to optimal job scheduling
			1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent
			100% billing of engineer work hours is due to use of technology in the service process.
			1=Least Extent, 2= Low Extent 3=Moderate Extent,4= High Extent, 5=Great Extent

Source: Researcher (2021)

2.6 Chapter Summary

This chapter has covered the theoretical and the empirical fundamentals of this study. The study was based on the human capital theory and the dynamic capability theories highlighting their underpinnings to the study. An empirical review was also caried out in line with the study objectives and the existing gaps identified.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the study methodology that was used to carry out the research. The chapter includes the research design, the target population to be studied, the sampling method used to gather the data, the sample size, data analysis, research quality and ethical considerations.

3.2 Research Philosophy

Researchers have developed four main research philosophical assumptions including: ontology, epistemology, axiology and methodology. In order to examine the three objectives forwarded in this study, the study adopted, ontological assumption which concerns with the nature of the world and human being in social contexts (Bryman, 2001). There are different assumptions to see the

world by outside individual and therefore effort is made to experience these realities through different perspectives of different individuals and through different experiences (Creswell, 2014). Therefore, ontology in normative emphasizes that social phenomenon is independent from other factors.

Philosophical assumptions are deeply rooted within various interpretive frameworks that researchers use when they conduct a study, including: positivism; post-positivism; interpretive; constructivism; transformative; and post-modernism among others (Creswell, 2014). This study will employ an interpretive research philosophical approach. In this research philosophy, the researcher pays critical attention on personal subjective significance about human beings conceiving logic of their environment and conveying meanings to it (Sarantakos, 2005). The major impact of this paradigm is that all the knowledge depends on the person interpreting it based on his or her experience and understanding.

3.3 Research Design

Research design is the organisation, planning, analysis and collection of data with the aim of providing adequate responses to the research questions which means that the choice of research design emanates from the key study objectives and questions (Creswell, 2009). The study adopted a descriptive cross-sectional research design. The study was cross-sectional and quantitative in nature aimed at to evaluating the variables within the objectives generating the correct inferences. A descriptive approach adopted, which, in essence, examined the existing condition to determine facts without any influence on the sample population. The descriptive approach was preferred because it looks at the what, how, where rather than the why. In this case, the descriptive research sought to reveal the effect of training, scheduling, and technology on optimized labor in the diesel generator service business in Kenya. The researcher adopted this methodology since it seeks to gather more knowledge to an existing problem to allow future additional research on the best way to optimize labor in diesel generator service business. This method also fits well with the study since it looks at the situation at a specific time (Sekaran & Bougie, 2016 ; Punch & Oancea, 2014).

3.3 Target Population

According to Punch and Oancea (2014), the target population refers to a large group that the researcher is interested in developing knowledge. The study population details were as indicated in the Tables 3.1 which shows the history, nature and years of existence of the companies in Kenya, as well as the specific numbers within the organizations located in Nairobi which were studied, categorized based on position in the organization. The study focused on the top nine diesel generator selling companies based on 2020 diesel generator market share data from Kenya bureau of Statistics (KBS) and a relatively long history in the diesel generator service business in Kenya. The study excluded Atlas Copco as they have discontinued their genset sales division. This study was restricted to the power generation industry but particularly to the diesel generator service business in Kenya located in Nairobi. Representative samples for each position used to avoid bias.

Cooper and Schindler (2007) highlight that a researcher can deliberately chose a specific population who are rich in the specific information and in this case because of age and experience these organizations are rich in information based on their experience in the industry and have their headquarters in Nairobi. The joint venture Cummins C&G ltd draws from both organizations that have got a long history in the power generation industry. To meet the objectives of the study, the criteria looked at senior, middle management, non-management staff and engineers. The reason for targeting the senior management was because of their rich knowledge in the service business. The middle management on the other hand were targeted because of their understanding of the day-to-day operations in the service business, the engineers were targeted because of their knowledge on the service environment from the actual service intervention perspective. Other staff constituted employees who have little or no interaction with generator business and were, therefore, not the main focus of this study as their input was not deemed to be significant.

According to Mugenda and Mugenda (2012) sample sizes ranging between 10% and 30% is representation enough of the target population hence this study considered 30% of the target population for sampling using the quota system of sampling.

Table 3.1: Target population company profile

Company	Description	Year of Incorporation	Total Population Nairobi
1. Cummins C&G Ltd	Joint Venture between Cummins Inc. and Car and General Trading Ltd. Cummins was formed in 1919 and Car and General was formed in 1936. Cummins C&G Ltd offers service to Cummins diesel generators in Kenya	2017	78
2. Car & General Ltd	Offers service to Cummins Diesel Generators	1936	173
3. Simba corporation	Offers service to Aksa Diesel Generators	1948	30
4. Blackwood Hodge	Offers service to FG Wilson Diesel Generators	1949	38
5. Mantac Group	Offers service to Caterpillar and Perkins Diesel Generators	1977	62
6. Achelis Kenya	Offers service to Pramac Diesel Generators	1960	95
7. Ryce Motors	Offers service to SDMO Diesel Generators	1966	94
8. Davies & Shirtliff Group	Offers service to Dayliff Diesel Generators	1946	175
	Total		745

The target population as presented in Table 3.2

Company Name	Senior Management	Middle Management	Service Engineer/ Technician	Other Non-Management	Populaation
Cummins C&G Ltd	6	12	18	42	78
Car & General Ltd	24	36	66	47	173
Simba Corporation	3	6	7	14	30
Blackwood Hodge	3	6	9	20	38
Mantrac Group	6	9	19	28	62
Achelis Kenya	3	9	24	59	95
Ryce Motors	6	21	27	40	94
Davies & Shirtliff Group	12	24	72	67	175
Total	63	123	242	317	745

3.4 Sampling Method

Punch and Oancea (2014) describes a sample as the smaller group within a target population that the study intents to focus its knowledge development. Mugenda and Mugenda (2012) state that a sample sizes between 10% and 30% is representation enough of the target population. In this study data was collected through a structured questionnaire based on a 5-point likert scale allowing the respondents to respond appropriately on the extent to which they agree with the statements.

A sample of staff working with diesel generators was selected based on non-probabilistic sampling to respond to questionnaires. Criteria for the choice of companies was that the company or its

affiliates ought to be in existence for more than 20 years and are involved with diesel generator service industry in Kenya.

For easy capture of information, a smaller sample from the entire population was sought. Nachmias and Nachmias (2008) formula was used to obtain representative data from the original population. Being a social science type of study a 95% confidence interval and *p*=0.05 was considered for the sample calculation.

$$n = \frac{N}{1 + N(e)\text{^}2}$$

Where:

n= Sample size

N=Population

e= Level of significance

$$n = \frac{719}{1 + 719(0.05)\text{^}2} = 257$$

The sample frame was as presented in Table 3.3

Table 3.3: Sampling frame distribution

Company Name	Senior Management	Middle Management	Service Engineer/Technician	Other Non-Management	Sample Population
Cummins C&G Ltd	2	4	16	6	28
Car & General Ltd	8	12	24	18	62
Simba Corporation	1	2	3	5	11

Blackwood Hodge	1	2	3	8	14
Mantrac Group	2	3	3	5	13
Achelis Kenya	1	3	8	22	34
Ryce Motors	2	7	9	16	34
Davies & Shirtliff Group	4	8	24	25	61
Total	29	59	87	46	257

Source: Research data (2021)

3.5 Data Collection Method

Primary data was collected using a questionnaire. According to Sekaran and Bougie (2016), the questionnaire allows respondents time to respond to the questions without supervision also with the questionnaire, it is possible to reach many people in a short time. The researcher has chosen a questionnaire specifically because it provided a detailed understanding the effects of training scheduling and technology on labor optimization in the diesel generator service business. Closed-ended questions used to allow for effortless coding and precision in data capture. Also used was a five-point Likert scale to capture the respondents' autonomous data relating to scheduling, training and technology, and their effect on labor optimization. The scale ranged from 1. Least extent, 2. low extent, 3. moderate extent, 4. high extent, 5. great extent. (Sekaran & Bougie, 2016 ; Cooper and Schindler, 2007).

In this study, primary data was obtained through the use of questionnaires given to respondents, as well as web-based questionnaires. The questionnaire comprised of the demographic information of the respondents such as age, level of education, length of service in the organization, position held in the organization, and perception on engineer working hours. It also comprised of 5-point Likert scale questions requiring respondents to give their level of agreement with statements regarding each of the study independent and dependent variables.

3.4 Data Analysis

Analysis refers to how we manipulate the data, categorize it, summarize it, and generate relevant answers to the study. The collected data from completed questionnaires was subjected to data cleaning to detect and correct any errors, omissions, outliers, normality, linearity and multicollinearity using the Statistical Package for Social Sciences (SPSS) software. This study used both descriptive and inferential statistical techniques to analyze the data collected. The descriptive techniques comprise of frequencies, percentages, mean scores and standard deviation, whereas the inferential statistical tools used Pearson's correlation analysis and regression analysis.

In this study, regression analysis was carried out whereby a model of a relationship was hypothesized in the form $Y= \beta_0+ \beta_1 X+ \varepsilon$ where β_0 $and \beta_1$ are model parameters and ε is the probabilistic error term that accounts for any variability in Y that cannot be described by the linear relationship with X (Cooper & Schindler, 2014). The following equation was fitted using multiple linear regression analysis.

$$Y=\beta_0+ \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon,$$

Where;

Y= Labor optimization

β_0 = Intercept

X_1 = Training

X_2 = Scheduling

X_3 = Technology

β_1, β_2, and β_3 are the coefficients of regression

ε = the error term

3.6 Research Quality

Validity and reliability were the main measures of research quality.

3.6.1 Validity

Validity refers to the measures used to assess the ability of the research tool to capture and measure the intended objectives. The results of which should be advanced having a high degree of accuracy with the ability of the findings to be generalized (Saunders et al. (2019). Construct validity in this study will be achieved by subdividing the questionnaire in line with the conceptual framework, addressing specific objectives. Content validity was achieved by closely tying the questions in the questionnaire to the study objectives. The researcher conducted a pilot study on ten per cent of the sample to achieve a quality study and to establish the questionnaire's reliability and validity. The pilot sample did not come from the sample populations of 257. Data from this pilot was used for testing the reliability of the instrument.

3.6.2 Reliability

Reliability is a measure of the degree to which a research instrument yields consistent and stable results or data after repeated trials (Eriksson and Kovalainen, 2015). The reliability and internal consistency was evaluated using Cronbach's Alpha. The test is utilized to check if questionnaires with multiple Likert scale questions are reliable. SPSS software was used to compute the Cronbach's Alpha. Gliem and Gliem (2003) recommended a value of 0.7 or greater as acceptable for the reliability test.

The findings indicated that scheduling had a coefficient of α=0.906, training had a coefficient of α=0.701, technology had a coefficient of α=0.703, and labor optimization had a coefficient of α=0.712. All variables depicted that the value of Cronbach's Alpha equivalent or above the value of 0.7 thus the study was reliable (Castillio, 2009). Therefore, the results represented high level of reliability and on this basis, it was assumed that scales used in this study are reliable to capture the variables.

Table 3.2: Test of Reliability

Variable	*Cronbach's alpha*	*Comment*
Labor optimization	0.712	Accepted
Scheduling	0.906	Accepted
Training	0.701	Accepted
Technology	0.703	Accepted

3.8 Ethical Considerations

According to Punch and Oancea (2014) ethical considerations refer to how the researcher recognised and dealt with the respondent's freedom to participate in the research, confidentiality, anonymity and treatment with respect was followed. Financial compensation to respondents was not allowed. Also, clearance from the Strathmore business school and clearance from the national commission for science and technology (NACOSTI) were sought. The capturing of the respondent's name was discouraged to achieve anonymity of the respondent. Data captured was interpreted without misrepresentation to ensure integrity. The findings were subjected to thorough analysis using Statistical Package for Social Sciences (SPSS).

3.9 Chapter Summary

This chapter has covered the research philosophy as well as the research design and data capture method used in the study. The chapter also highlights the target population with detail of how the samples were arrived ad and data collected. The last section of the chapter delves into the analysis method used to generate meaning from the data captured. Finally, the chapter addresses the fundamental aspects of data validity reliability as well as the ethical considerations that were considered in in the study.

CHAPTER FOUR
FINDINGS AND DATA ANALYSIS

4.1 Introduction

This chapter encompasses the analysis and presentation of the research findings. It presents the demographic information of the study respondents and the findings are organized per the study objectives. The study had an anticipated sample size of 254 respondents but only 224 responded giving a response rate of 88.2% which was sufficient for analysis.

4.2 Demographic Information

The study presents respondents' information in terms of their gender, age, education, level of employment at the company, years of service and perceptions on engineer working hours.

4.2.1 Gender of respondents

In terms of gender distribution, 67.9% were males and 32.1% were females. The diesel generator service business is predominantly an engineering industry and reveals that the uptake of women in engineering related industry like diesel generator business still has requires advancement for it to achieve gender parity.

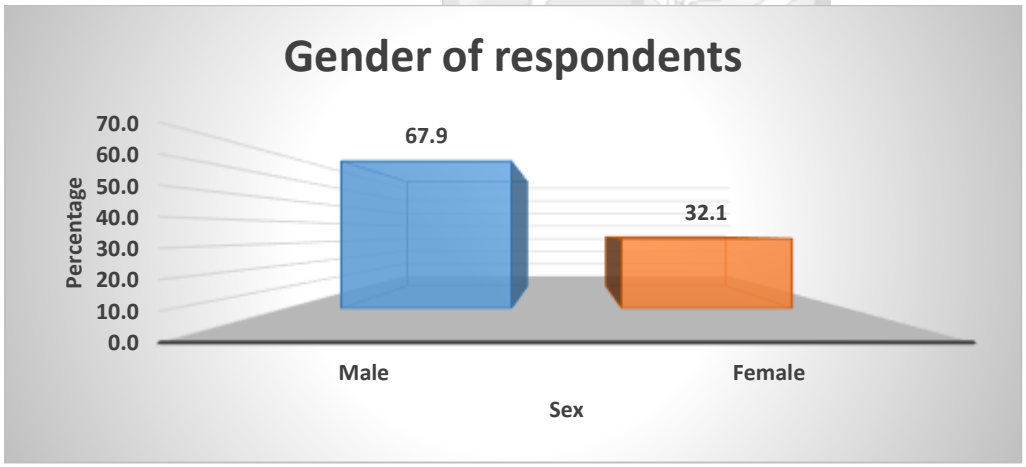


Figure 4.1: Distribution of respondents by gender

Source: Research data (2021)

4.2.2 Age of respondents

The study targeted respondents of different age categories where both young and old were selected to participate in the study as shown in Figure 4.2 below.

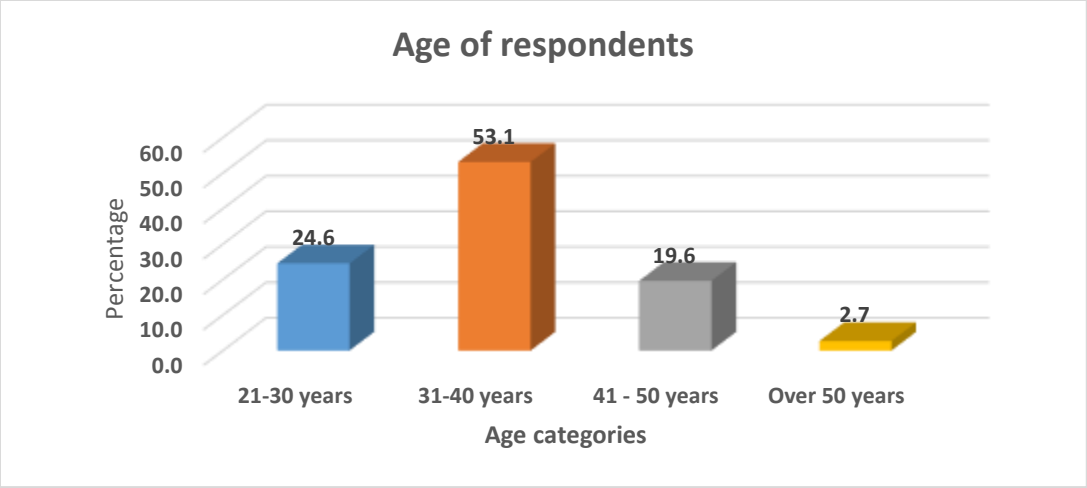


Figure 4.2: Distribution of respondents by age

Source: Research data (2021)

From the results in Figure 4.2, 24.6% of the respondents were young people aged between 21 - 30 years, 53.1% of the respondents reported ages of between 31-40 years, 19.6% of the respondents were aged between 41 – 50 years, while those who were above 50 years accounted for only 2.7% as shown in Figure 4.2. This implies that more diesel generator companies are getting younger employees probably due to the rigorous work involved.

4.2.3 Level of employment

The study sought to establish the level of employment of respondents. This was to get perceptions from different cadres of employment. The results were as illustrated in Figure 4.3 below.

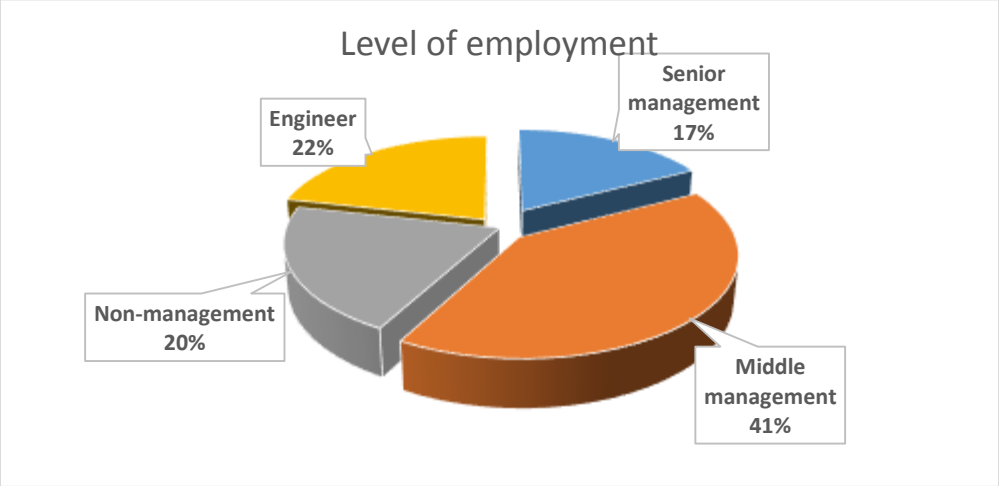


Figure 4.3: Distribution of respondents by level of employment

Source: Research data (2021)

Based on the results above, most of the respondents were middle level managers (41%), followed by engineers (22%), non-management staff (20%) while senior management staff accounted for 17% of the respondents. This shows there was a mix in the distribution of respondents thereby the views presented in this study represents the opinion of the different cadres in the companies.

4.2.4 Highest level of education

The study, further, sought to establish the highest level of education the respondents had attained. This was done by level of employment to get how education was distributed in the different level of employment or rather if education was a factor in the employment level of respondents. The results were as shown in Table 4.1 below.

Table 4.1: Highest level of education

		Highest academic qualification				
		Certificate	Diploma	Bachelor's degree	Master's Degree	Other
Senior management	n	0	13	11	14	1
	%	0.0%	33.3%	28.2%	35.9%	2.6%
Middle management	n	2	15	61	13	0
	%	2.2%	16.5%	67.0%	14.3%	0.0%
Non-management	n	9	12	22	3	0
	%	19.6%	26.1%	47.8%	6.5%	0.0%
Engineer	n	0	22	18	3	5
	%	0.0%	45.8%	37.5%	6.3%	10.4%
Total	n	11	62	112	33	6
	%	4.9%	27.7%	50.0%	14.7%	2.7%

Source: Research data (2021)

Generally, all the respondents in this study had completed secondary school education and had at least some tertiary level education. In this regard, half of the respondents reported to have attained a bachelor's degree, 27.7% of the respondents had completed diploma courses, 14.7% had attained a master's degree while only 4.9% had certificate level of education. This implies that the

respondents were qualified enough academically to understand the research topic and respond adequately. This indicates that all the respondents were qualified personnel with adequate knowledge and skills in their areas of work.

4.2.5 Length of service

In terms of length of service in the diesel generator companies, four in every ten respondents (40%) reported to have worked in the company for between two to six years. Moreover, 29% reported experience of more than 10 years, followed by those who had between 7 to 10 years of experience and those with less than two years of experience (21% and 10% respectively). This therefore shows that majority of the respondents had adequate experience to understand the operations of diesel generator companies.

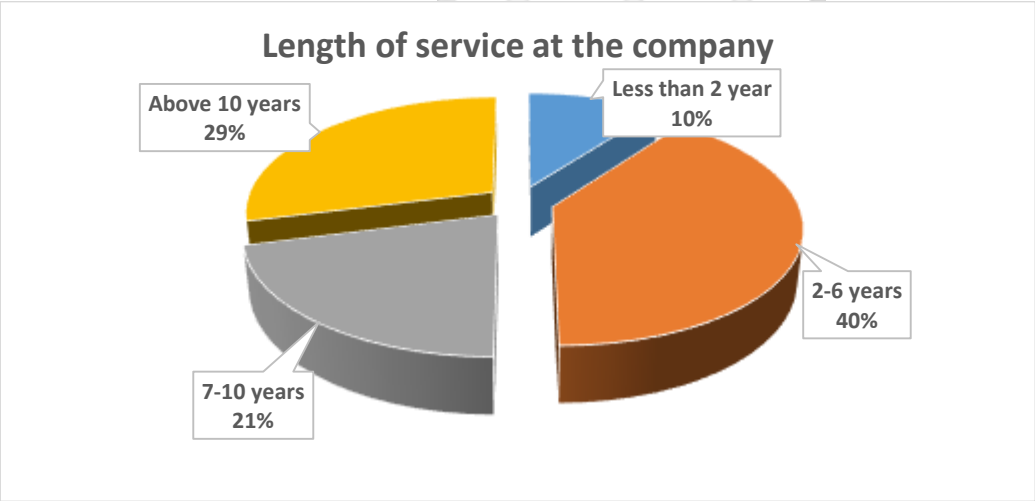


Figure 4.4: Length of service

Source: Research data (2021)

4.2.6 Perceptions on engineer working hours

The study also sought to get respondents' perceptions on how many hours an engineer is required to work per day. This was geared to informing on whether the labor provided by the engineers was optimized. Working hours was also essential in helping the respondents have a sense of how much of the engineer hours were billed relative to the total available hours by bringing context to the questions.

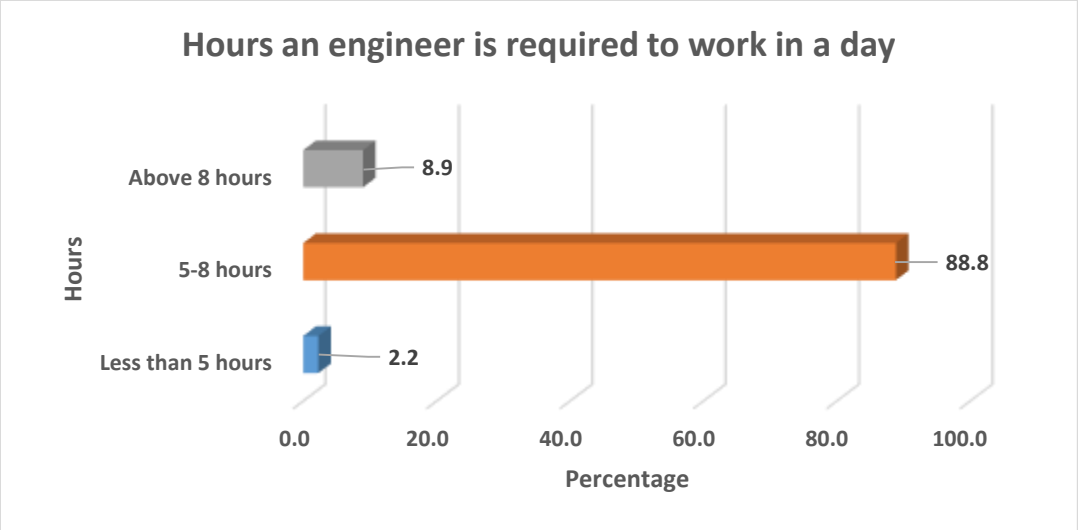


Figure 4.5: Hours an engineer is required to work in a day

Source: Research data (2021)

Based on the results, an overwhelming majority (88.8%) of the respondents indicated that an engineer is supposed to work for between 5-8 hours in a day. This was followed by 8.9% of the respondents who opined that, engineers are required to work for more than 8 hours while only 2.2% had the opinion than engineers should work for less than 5 hours in a day. Since the study involved questions on how much engineer time was billed, the different respondents from different organizations, the findings reveal their varied view of what constitutes the total engineer hours. Those who perceived more than eight hours could have viewed the engineer as someone who needs to be on call round the clock while those who looked at less hours may have perceived it from the point of view that even engineers should be able to go on leave excluding some hours to accounts for hours away from direct work.

4.3 Descriptive results

This section presents results from descriptive analysis and is organized based on the objectives. The researcher formulated statements responding to different aspects of the objectives where respondents were required to give their level of agreement.

4.3.1 Role of training on labor optimization in diesel generator service business

The first objective of the study sought to establish the role of training on labor optimization in diesel generator service businesses in Nairobi. Under this objective, the researcher formulated statements relating to training and respondents were required to state the extent to which different aspects affects labor optimization in their companies. The results were as shown in Table 4.2 below.

Table 4.2: Level of agreement with statements regarding training

	Mean	Std. Deviation
By training all engineers, the organization is able to optimize labor of all engineers	4.14	0.802
Trained engineers in my organization take a shorter time on service and repair of gensets compared to untrained engineers	4.02	0.898
Engineer training in my organization is offered to improve skills and optimize labor	3.94	1.007
Quick Job turnaround in my organization is mainly contributed by trained engineers	3.92	0.939
Engineers in our organization are trained on the equipment they service	3.9	1.102
In our organization trained engineers bill 100% of their required work hours in a day	3.56	0.95
Untrained engineers contribute to most of the repeat service jobs	3.16	1.227
Overall Mean	3.81	

Source: Research data (2021)

Results on Table 4.2 above revealed that the respondents were inclined to agree that training had a high influence on labor optimization in their companies. In this regard, most of the statements yielded a mean score of more than 3.5 meaning that majority of the respondents were in agreement with the statements. Majority of the respondents agreed that by training all engineers, the organization is able to optimize labor of all engineers (mean score of 4.14), that trained engineers in their organizations take a shorter time on service and repair of gensets compared to untrained engineers (4.02). However, there was divided opinion on the contribution of untrained engineers

(mean score of 3.16). This is a clear indication that training plays a major role in optimization of labor in diesel generator service businesses. The overall mean score was 3.81 implying that training had an impact on labor optimization to a moderate extent.

4.3.2 Role of scheduling on labor optimization in diesel generator service business

The second objective of the study sought to establish the role of scheduling on labor optimization in diesel generator service businesses in Nairobi. Under this objective, the researcher formulated statements relating to scheduling and respondents were required to state the extent to which different aspects affects labor optimization in their companies. The results were as shown in Table 4.3 below.

Table 4.3: Level of agreement with statements regarding scheduling

	Mean	Std. Dev
My organization plans and schedules generator service jobs in advance	3.71	0.883
Scheduling in our organization is based on the situation and both priority and strict schedules are used appropriately	3.65	1.009
Engineer Scheduling in our organization is based on priority jobs	3.61	0.991
In our organization scheduling ensures 100% billing of required work hours per day	3.38	1.145
My organization uses non-static scheduling to help optimize engineer labor in order to overcome obstacles that arise	3.20	1.011
In my organization the scheduling process of service engineers considers traffic jam to optimize engineer labor	2.89	1.091
Scheduled jobs in my organization are often interrupted by adhoc jobs that need to be given priority on the schedule	2.71	1.126
Engineer Scheduling in our organization is based on a schedule that does not change	2.23	1.045
Overall Mean	3.17	

Source: Research data (2021)

Based on the results in Table 4.3, the respondents had varied opinion about the contribution of various aspects regarding scheduling. Most of the respondents agreed that their organizations plan

and schedules generator service jobs in advance (mean score of 3.71), that scheduling in their organizations was based on the situation where both priority and strict schedules were used appropriately (3.65) and that engineer scheduling in their organizations was done based on the priority jobs (3.61). With mean score of around 2.5 to 3.5, the number of the respondents who agreed with certain statements about scheduling was almost similar to those who disagreed with the statements. For instance, the respondents were neutral (not decided) on the whether their organizations' scheduling ensures 100% billing of required work hours per day (3.38), whether their organizations moderately use non-static scheduling to help optimize engineer labor in order to overcome obstacles that arise (3.20), if the scheduling process of service engineers considers traffic jam to optimize engineer labor (2.89), and whether scheduled jobs are often interrupted by adhoc jobs that need to be given priority on the schedule (2.79). finally, most of the respondents disagreed that scheduling in their organizations is based on a schedule that does not change (mean score of 2.23). The overall mean was 3.17 and this implied that scheduling also had a moderate impact on labor optimization.

4.3.3 Role of technology on labor optimization in diesel generator service business

The third objective of the study sought to establish the effect of technology on labor optimization in diesel generator service business in Kenya. Under this objective, the researcher formulated statements relating to technology and respondents were required to state the extent to which different aspects affects labor optimization in their companies. The results were as shown in Table 4.4 below.

Table 4.4: Level of agreement with statements regarding technology

	Mean	Std. Dev
In my organization technology is used in the service job planning	3.83	1.020
The overall use of technology in our service organization contributes to labor optimization	3.73	0.914
My organization uses technology to measure the efficiency of the service event	3.62	0.972
Technology is applied in the entire diesel generator service process	3.60	0.956

In our organization technology ensures we bill 100% of the engineer daily work hours	3.54	0.979
My organization technology enables engineers to complete service work on a generator as planned	3.52	1.020
In my organization technology enables us to detect engineer idle time	3.36	1.096
Overall Mean	3.60	

Source: Research data (2021)

Based on the results in Table 4.4, majority if the respondents were in agreement that their organizations used technology in the service job planning (3.83), that the overall use of technology in their service organization contributed to labor optimization (3.73) and that their organizations use technology to measure the efficiency of the service event (3.62). however, the respondents were neutral on whether their organizations enable them to detect engineer idle time (mean score of 3.36). The overall mean score was 3.60 which implied that technology had and impact on labor optimization to a moderate extent but relatively higher that in scheduling and training.

4.3.4 Labor optimization in diesel generator service business

The study also sought to examine labor optimization in the diesel generator service business. The researcher formulated statements relating to labor optimization and respondents were required to state the extent to which different aspects affect the diesel generator service business. The results were as shown in Table 4.5 below.

Table 4.5: Level of agreement with statements regarding labor optimization

	Mean	Std. Dev
In my organization labor optimization in diesel generator service business is important	4.13	0.850
Recovery of 100% of our engineer labor hours is greatly dependent on the manager scheduling techniques	3.54	0.927
My organization uses labor optimization to calculate the total number of engineers required	3.52	1.112
In our organization recovery of 100% of the engineer labor hours is significantly dependent on the engineer training	3.48	0.820

Our organization's recovery of 100% of the available engineer labor hours is to a great extent dependent on technology	3.38	0.999
Overall Mean	3.61	

Source: Research data (2021)

Results on Table 4.5 present the mean scores of the responses on the various statements regarding labor optimization. The mean scores represent the degree which the respondents agreed or disagreed with the statements. For instance, with a mean score of 4.13, most of the respondents had agreed that labor optimization in their organizations in diesel generator service business is important. In addition, majority of the respondents agreed that recovery of 100% of the engineer labor hours is greatly dependent on the manager scheduling techniques (3.54) and that their organizations use labor optimization to calculate the total number of engineers required (3.52).

On the other hand, respondents were undecided if recovery of 100% of the engineer labor hours is significantly dependent on the engineer training (3.48) and whether the recovery of 100% of the available engineer labor hours is to a great extent dependent on technology (3.38). the overall mean was 3.61 which implies that labor optimization was of moderate importance to the organization helping with running an efficient diesel generator service business.

4.4 Regression Analysis

4.4.1 Diagnostic tests for Multiple linear regression

Prior to carrying out multiple linear regression analysis, it is advisable to conduct diagnostic tests to ascertain whether the data is fit for

4.4.1.1 Factor Analysis

Before conducting diagnostic tests, factor analysis was done to identify factors which may not be instrumental to the study. Factor analysis is a dimension reduction method that acts as a gauge of the substantive importance of a given variable to the factor and it was used to identify and remove hidden constructs or variable items that do not meet the objectives of the study and which may not be apparent from direct analysis (David *et al*., 2010). Communalities and eigenvalues was used to show the substantive importance of variable factors. In this study eigenvalues for each variable were extracted using principal component analysis. The components with eigenvalues of 1 and

above were used for further analysis. These were combined by addition to come up with a composite variable with maximum variation to be used in regression analysis.

4.4.1.2 Normality test

Normality test is central to statistics especially when parametric tests such as correlation and regression analysis are to be used. Therefore, in this study normality tests were carried out and used to determine if the data is well modelled and normally distributed (Gujarati, 2002). The study applied Kolmogorov-Simonov normality test whereby in Kolmogorov-Simonov test, if the test of normality yields a figure of less than 0.05 it means that the data is not normally distributed. The Kolmogorov and Shapiro-Wilk test helps us conclude whether our data is not normally distributed or not.

H_0: The data is not normally distributed

H_1: The data is normally distributed or not from a normal distribution.

Table 4.6: Normality tests

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Labor Optimization	.131	220	0.162	.939	220	0.064

a. Lilliefors Significance Correction

From the results, both the Kolmogorov-Simonov and Shapiro-Wilk tests yielded a p-value of more than the alpha value of 0.05. This implies that both tests passed the normality threshold therefore the response variable is normally distributed.

4.4.1.3 Multicollinearity

Multicollinearity will be tested in the study using correlation matrix whereby the cut-off point for severe Multicollinearity is 0.8 (Gujarati, 2003; Cooper & Schindler, 2008). Variance inflation factor was also used to measure multicollinearity since it is more conclusive than Pearson correlation coefficients. The assumption for multicollinearity states that, when the VIF value lies between 1 and 10, then there is no multicollinearity. Multicollinearity leads to large standard errors

that affect the precision and accuracy results. Based on the results below, all the VIF values lie between 1 and 10 thus there is no multicollinearity in the data.

Table 4.7: Collinearity Statistics

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Scheduling	0.740	1.351
	Training	0.478	2.092
	Technology	0.478	2.090

4.4.1.4 Autocorrelation

Durbin-Watson test for autocorrelation was conducted to establish whether or not the residuals are serially correlated. The Durbin Watson test reports a test statistic, with a value from 0 to 4, where: 2 denotes no autocorrelation; 0 to 2<2 denotes a positive autocorrelation, while >2 denotes a negative autocorrelation. The decision rule is that test statistic values in the range of 1.5 to 2.5 are relatively normal. Values outside this range could be cause for concern (Field, 2009). The results from the Durbin-Watson test for autocorrelation value of 1.652 shows that the variables were not auto-correlated.

4.4.1.5 Heteroscedasticity

The data for the study is from a cross-section of companies, thus raising the concerns about the existence of heteroscedasticity. The CLRM assumes that the error term is homoscedastic, that is, it has constant variance. If the error variance is not constant, then there is heteroscedasticity in the data. To test for heteroscedasticity, the Breusch-Pagan/Koenker test was used and results of the test are as presented below.

------- Breusch-Pagan and Koenker test statistics and sig-values --------

	LM	Sig
BP	11.352	0.061
Koenker	14.379	0.532

Null hypothesis: heteroskedasticity not present (homoskedasticity)

if sig-value less than 0.05, reject the null hypothesis

Note: Breusch-Pagan test is a large sample test and assumes the residuals to be normally distributed

Therefore, we do not reject the null hypothesis and conclude that the residuals have an equal variance thus presence of homoscedasticity in the data.

4.4.2 Correlation analysis

Correlation analysis was also conducted in order to determine the direction and the strength of the relationship between the dependent variable and independent variable(s). Here, Pearson correlation coefficient was used to determine the magnitude and the direction of the relationships between the dependent variable and independent variables. The correlation coefficient (R) values are supposed to be between -1 and +1. According to Kothari (2012) a value of 0 implies no relationship, +1 correlation coefficient indicates that the two variables are perfectly correlated in a positive linear sense, that is, both variables increase together while a value of -1 correlation coefficient indicates that two variables are perfectly correlated in a negative linear sense, which means that one variable increases as the other decreases. Pearson Correlation Coefficient was computed to show the relationship existing between the variables and the results were presented in Table 4.8.

The study dependent variable was labor optimization in diesel generator companies in Nairobi and the independent variables were scheduling, training and technology.

Table 4.8: Correlation matrix

		Labor Optimization	Scheduling	Training	Technology
Labor Optimization	Pearson Correlation	1	.606**	.768**	.789**
	Sig. (2-tailed)		0.000	0.000	0.000
	N	224	224	224	224
Scheduling	Pearson Correlation	.606**	1	.471**	.470**
	Sig. (2-tailed)	0.000		0.000	0.000
	N	224	224	224	224
Training	Pearson Correlation	.768**	.471**	1	.705**

	Sig. (2-tailed)	0.000	0.000		0.000
	N	224	224	224	224
Technology	Pearson Correlation	.789**	.470**	.705**	1
	Sig. (2-tailed)	0.000	0.000	0.000	
	N	224	224	224	224

As evidenced by the results in Table 4.8, there was a strong positive and significant relationship between scheduling and labor optimization (r= 0.606, n=224; p < 0.001). This implies that an increase in scheduling would increase labor optimization and a decrease in scheduling would also lead to a decrease in labor optimization. The results, further, revealed that there was a strong, positive and a significant association between training and labor optimization in diesel generator companies (r = 0.768, n=224, p < 0.001). This was also similar with technology where there was a positively strong association between technology and labor optimization in generator companies in Nairobi (r = 0.789, n=224, p < 0.001).

4.4.3 Multiple linear regression analysis

Regression analysis was conducted to determine the linear statistical relationship between the dependent and independent variables of the study. Regression analysis can also be used determine the strength of the relationship between the independent and dependent variables and to determine the combined effect of all the independent variables on the dependent variable (Cooper & Schindler, 2010). The coefficient of determination (R-square) was used to measure the change in dependent variable explained by the change in independent variable(s) while F –test was carried out to evaluate the significance of the overall model and to define the relationship between the dependent variable and independent variables.

Goodness of fit

Goodness of fit of the model refers to how well the model explains the variations in the dependent variable (Gujarati, 2012). It evaluates whether the model is good, reliable and valid to be used for prediction. In this study, the R squared, Standard error of estimate (S.E.) and the F-test statistic were used respectively to evaluate the goodness, reliability and validity of the various models. In this study F-test was used further to determine the validity of the model while R squared was used as a measure of the model goodness of fit. The regression coefficient summary was then used to explain the nature of the relationship between the dependent and independent variables.

Coefficient of Determination explains the extent to which the change in the dependent variable can be explained by the change in the independent variables or the percentage of variation in the dependent variable that is explained by all the independent variables. The coefficient usually lies between 0 and 1 whereby 0 indicates a complete lack of fit while 1 indicates a perfect fit. Therefore, the closer it is to 1 the better the fit.

Table 4.9: Model summary

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.868[a]	0.754	0.750	0.34908	1.652

a. Predictors: (Constant), Technology, Scheduling, Training
b. Dependent Variable: Labor optimization

From Table 4.9, the coefficient of determination (R-squared) of 0.754 shows that 75.4% of labor optimization in diesel generator companies can be explained by scheduling, training and technology. The adjusted R of 0.75% indicates that the independent variables explained the variation in labor optimization by 75%, while the remaining variation (25%) can be explained by other factors not included in the model. An R of 0.868 shows that there is a positive correlation between the dependent and independent variables.

Table 4.10: ANOVA Table

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	82.010	3	27.337	224.332	.000[b]
	Residual	26.809	220	0.122		
	Total	108.818	223			

a. Dependent Variable: Labor optimization
b. Predictors: (Constant), Technology, Scheduling, Training

Analysis of Variance (ANOVA) was used to test the overall significance of the regression model. The null hypothesis for this test is that the predictor variables do not have explanatory power ($\beta_1 = \beta_2 = \beta_3 = 0$). The p-Value of <0.001 means that the R squared is significantly greater than zero thereby our predictors can account for a significant amount of variance in labor optimization. With

a significant p-value, we reject the null hypothesis and adopt the alternative hypothesis and conclude that the predictors have explanatory power ($\beta_1 \neq \beta_2 \neq \beta_3 \neq 0$). Therefore, the regression model is significant ($F_{(3, 223)} = 224.332$, $p<0.001$; $R^2 = 0.754$).

Table 4.11: Multiple regression coefficients

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	0.141	0.143		0.985	0.326	-0.141	0.422
	Scheduling	0.260	0.042	0.238	6.118	0.000	0.176	0.343
	Training	0.348	0.047	0.355	7.333	0.000	0.254	0.441
	Technology	0.367	0.042	0.427	8.827	0.000	0.285	0.449

From the results, the following multiple linear regression model was fitted,

$$Y = 0.141 + 0.260X_1 + 0.348X_2 + 0.367X_3$$

Where;

Y – Labor optimization

X_1 – Scheduling

X_2 – Training

X_3 - Technology

Multiple regression analysis was used to determine whether independent variables, (scheduling, training and technology) simultaneously influence the dependent variable (Y) which is labor optimization. From the regression results in Table 4.11, the beta coefficients X_1 ($\beta = 0.260$, p-value < 0.001), X_2 ($\beta = 0.348$, p-value < 0.001), and X_3 ($\beta=0.367$, p-value < 0.001) implies a significant relationship between scheduling, training, technology and labor optimization. In this regard, a 100% increase in scheduling activities would increase labor optimization by 26% when all other factors are held constant. Similarly, holding other factors constant (scheduling and technology) a 100% increase in training activities would lead to a 34.8% in labor optimization whereas when technology activities are increased by 100%, they would increase labor optimization

by 36.7%, if scheduling and training are kept constant. This can also be interpreted as follows from a factor perspective.

Constant = 0.141 means that if scheduling training and technology variables are rated as zero or held constant labor optimization would be a factor of 0.141.

$X_1 = 0.260$ shows that one unit increase in scheduling results in an increase in labor optimization by a factor of 0.260.

$X_2 = 0.348$ shows that one unit increase in training results in an increase in labor optimization by a factor of 0.348.

$X_3 = 0.367$ shows that one unit increase in technology results in an increase in labor optimization by a factor of 0.367.

From the above multiple linear regression model holding scheduling, training and technology constant, labor optimization would be at 0.141. It can also be seen that though all the labor optimization variables have a positive influence on the dependent variable, training and technology have a larger effect labor optimization compared to scheduling. The overall feeling of the respondents is that all independent variables had a significant influence on the dependent variable labor optimization.

4.5 Chapter Summary

This chapter analyzed the data based on the findings presented from the study. The information captured was then interpreted using the relevant literature. The chapter also provided a summary of the key findings in relation to the objectives of the study covering the theoretical and the empirical fundamentals.

CHAPTER FIVE
DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter focuses on the discussion of the study findings, summary of the study, conclusions based on the findings, recommendations and areas of further research.

5.2 Discussion of Findings

This section discusses the findings above in relation to other research studies conducted. The section is organized as per the objectives and include comparison with other studies. The study objectives included the examination of the role of training on labor optimization, the examination of the role of scheduling on labor optimization as well as the effect of technology on labor optimization in diesel generator service business in Kenya.

5.2.1 Role of scheduling on labor optimization in diesel generator service business

The first objective of the study sought to establish the role of scheduling on labor optimization in diesel generator service businesses in Nairobi. Under this objective, the researcher formulated statements relating to scheduling and respondents were required to state the extent to which different aspects affects scheduling activities in their companies. The findings indicated that most organizations had planned and scheduled generator service jobs in advance. These findings concur with the works of Voessing and Kunze von Bischhoffshausen (2018) who also agree that there is need for better scheduling and planning methods to reduce uncertain occurrences.

According to the findings, most of the scheduling within the studied organizations was based on the situation where both priority and strict schedules were used appropriately. Engineer scheduling was also based on priority jobs and most organizations' scheduling ensured 100% billing of required work hours per day. These findings are supported by the work of Irawan et al. (2017) who highlighted that for service maintenance costs to remain low, there was a need to optimize maintenance schedules. Non-static scheduling was also used to help optimize engineer labor in order to overcome obstacles that arise. Nevertheless, the results indicated that not all organizations considered traffic jam to optimize engineer labor. Interruption of scheduled jobs by adhoc jobs

that needed to be given priority on the schedule was also a common finding among the organizations.

In addition, the findings indicated that engineer Scheduling in only a few organizations was based on a schedule that did not change while the rest of the organizations relied on a changing and flexible schedule. However, other studies continue to discuss the challenges that arise with scheduling. According to Yumbe and Norihisa (2019), traditional scheduling methods look at the engineer's expertise, work shift to be covered, and the nature of the customer request. The study points out that this type of scheduling technique comes with associated problems and the initial schedule could be interrupted by unforeseen events causing rescheduling to take place.

5.2.2 Role of training on labor optimization in diesel generator service business

The second objective of the study sought to establish the role of training on labor optimization in diesel generator service businesses in Nairobi. Under this objective, the researcher formulated statements relating to training and respondents were required to state the extent to which different aspects affects labor optimization in their companies. The findings indicated that training had a high influence on labor optimization in most of the companies. By training all engineers, most of the organizations were able to optimize labor of all engineers to a great extent. Most of the trained engineers in these organizations took a shorter time on service and repair of gensets compared to untrained engineers, a clear indication that training plays a major role in optimization of labor in diesel generator service businesses.

These findings concur with the work of Kulkarni (2013), who points out that training is developing skills and attitudes systematically allowing an individual to perform a particular assignment. The findings established that to a great extent, engineer training in these organizations was offered to improve skills and optimize labor while quick job turnaround in the organizations was mainly contributed by trained engineers. This is reiterated by Chong (2010), who mentions that the need for constant training is necessary to manage organizational needs focusing on specific goals and activities that close these skill gaps. The findings also indicated that most engineers in the studied organizations were trained on the equipment they service, and they billed 100% of their required work hours in a day.

Training benefits are also mentioned in the works of Caldarola et al. (2018) as they state that training while on the job created concrete competencies tailored to each employee which as a result led to better performance on the job. On the other hand, despite highlighting the benefits of training, some studies mention the other effects of cross-training. Oh (2010) in their study introducing the aspect of cross training and specialization highlighted the importance of training in a firm but raised the fact that beyond a certain number of tasks, cross training would not deliver increased benefit to the organization.

5.2.3 Role of technology on labor optimization in diesel generator service business

The third objective of the study sought to establish the effect of technology on labor optimization in diesel generator service business in Kenya. Under this objective, the researcher formulated statements relating to technology and respondents were required to state the extent to which different aspects affects labor optimization in their companies. The findings indicated that most organizations used technology in the service job planning, while the overall use of technology in the service organizations contributed to labor optimization. These findings concur with the work of Strutynska et al. (2019) who argues that technology is the tool firms use to not only gain competitive advantage and improve internal efficiency but also help firms differentiate the firm's business activities in the wake of rising competition. The study findings, further, indicated that in most cases, technology was used to measure the efficiency of the service event and was applied in the entire diesel generator service process while ensuring that the organizations billed 100% of the engineer daily work hours.

These findings concur with the works of Jain et al. (2016) who performed a study of optimization of labor productivity using work measurement techniques. The study helped establish the standard time required to complete a task to eliminate fatigue on workers. The author also highlighted the need for measurement and highlighted that different organizations have different methods of capturing time taken by workers and that there were sophisticated computer systems that could help with tracking efficiency and labor optimization so as to capture this. Furthermore, organization technology enabled engineers to complete service work on a generator as planned

and when it comes to technology aiding the detection of engineer idle time, this was possible in most organizations.

5.2.4 Labor optimization in diesel generator service business

The study further sought to examine labor optimization in the diesel generator service business. The researcher formulated statements relating to labor optimization and respondents were required to state the extent to which different aspects affect the diesel generator service business. The findings indicated that in most organizations, labor optimization in diesel generator service business was important. The recovery of 100% of the engineer labor hours was greatly dependent on the manager scheduling techniques, the engineer training and on technology. To a great extent, most of the organizations used labor optimization to calculate the total number of engineers required.

5.3 Conclusions

This section covers conclusions of this study based on research findings. The study sought to establish the effects of training, scheduling and technology on labor optimization in diesel generator service business in Kenya. The first objective of the study sought to examine the role of training on labor optimization in diesel generator service business in Kenya. Under this objective, the study concluded that training had a positive impact on labor optimization as the nature of work of the studied organizations depended mainly on high technological and sophisticated equipment. This made training of the staff critical and vital. This conclusion is supported by the fact that most of the trained engineers in the studied organizations took a shorter time on service and repair compared to untrained engineers, a clear indication that training plays a major role in optimization of labor.

The second objective of the study sought to examine the role of scheduling on labor optimization in diesel generator service business in Kenya. Under this objective, the study concluded that it is crucial to plan and schedule staff jobs in advance as this has a direct positive impact on labor optimization. The study concludes that both training and scheduling are key stimulants that are required to improve the staff performance and capabilities, which consequently optimize labor and

increase organizational productivity. This is supported by the Human Capital Theory that is based on the principle that humans and society derive value in investing in people.

The third objective of the study sought to examine the effect of technology on labor optimization in diesel generator service business in Kenya. Under this objective, the study concluded that the adoption of technology had an importance influence on labor optimization and staff job performance. Technology adoption reduced human error and increased productivity by enabling the organizations to measure efficiency while ensuring staff complete work as planned by aiding the detection of any staff idle time. The study was guided by the adopted Dynamic capability theory especially when it comes to the use of technology to optimize labor by enabling organizations to integrate seize and reconfigure internal capabilities and resources adapting to the ever-changing business environment. In conclusion, training, scheduling and the use of technology should be designed based on organization specific needs and objectives. The results of this study affirm the proposition that training, scheduling and technology have a positive impact on labor optimization in diesel generator service business in Kenya.

5.4 Recommendations

Training, scheduling, and technology affect labor optimization in different ways. The study finding reveal that many of the studied organizations have come to the realization of the importance of the role that training, scheduling and technology when it comes to labor optimization by increasing the staff's efficiency, skills and productivity. Therefore, this study makes the following recommendations:

For successful training within the organizations, there is need for the identification of training needs. This should be done more professionally in conjunction with the management as well as individuals involved together with the Human Resource personnel. This is to ensure that everyone involved agrees exactly to what the trainees are lacking and what skills are required, and what attitudes need to be changed towards labor optimization and work performance.

It is vital to monitor and evaluate training, scheduling and technology use in order to assess its effectiveness in producing the expected outcomes and ensuring labor optimization while indicating

where improvements or changes are required to make it even more effective. Organizations should see training, scheduling and the use of technology as a continuous process for organizational development and survival.

The study also recommends that organizations should embrace the adoption of technology in order to have a competitive edge and improve service delivery to customers, have more self-service enabled services, automate all critical processes to achieve higher efficiency, reliability and control in the organization while optimizing labor.

5.5 Limitations of the study

This study was limited to the labor optimization systems in the Diesel Generator service business in Kenya. The study having been done during the COVID 19 pandemic season made it difficult to get respondents in their offices creating some delay with data collection and getting responses from the people.

5.6 Suggestions for Further Research

Future researchers should examine the relationship between organization culture, organizational strategies, human resource strategies and labor optimization. The study also only focused on the diesel generator service business in Kenya, which is just a single business. Further research can be carried out in other institutions as it will go a long way to improve the effectiveness as well as efficiency of staff and thus aid the human resource personnel to design good training, schedules and appropriate adoption of technology to suit their workforce.

REFERENCES

Abeberese, A., Ackah, C., & Asuming, P. (2019). *Productivity Losses and Firm Responses to Electricity Shortages: Evidence from Ghana*. https://doi.org/10.1093/wber/lhz027

Achieng, S. T. L. L. A. (2013). *Job Satisfaction And Employee Performance Within The Telecommunication Industry in Kenya: A Case Of Airtel Kenya Limited.* Kenyatta University.

Adebowale, O., & Fapohunda, A. (2015). *ANALYSIS OF CONSTRUCTION-RELATED FACTORS AFFECTING THE EFFICIENCY OF CONSTRUCTION LABOUR*.

Allkott, H., Collard-Wexler, A., & O'Connell, S. (2016). Allcott, H., Collard-Wexler, A., & O'Connell, S. D. (2016). How do electricity shortages affect industry? Evidence from India. 106(3), 587-624. *American Economic Review*, 106(3), 587-624.

Al-Rawi, O., & Mukherjee, T. (2019). Application of Linear Programming in Optimizing Labour Scheduling. *Journal of Mathematical Finance*, *09*, 272–285. https://doi.org/10.4236/jmf.2019.93016

Amstrong, M. (2006). *A handbook of human resource management practice.* (8th Edition). Kogan Page Publishers.

Andreeva, T., & Ritala, P. (2016). What are the sources of capability dynamism? Reconceptualizing dynamic capabilities from the perspective of organizational change. *Baltic Journal of Management.*

Babbie, E. (2010). *The Basics of Social Research* (4th ed.). Thompson Wadsworth.

Bleady, A., Ali, A., & Ibrahim, S. (2018). Dynamic capabilities theory: Pinning down a shifting concept. . *Academy of Accounting and Financial Studies Journal*, 22(2), 1–16.

Breidbach, C., Kolb, D., & Srinivasan, A. (2013). Connectivity in service systems: Does technology-enablement impact the ability of a service system to co-create value?. *Journal of Service Research*, 16(3), 428-441.

Brown, R. E. (2017). *Electric power distribution reliability.* CRC press.

Caldarola, E., E., G., G, E., & Sacco, M. (2018). *Enhancing the Workforce Skills and Competences by Leveraging a Human-Centered Knowledge-Based System in the Rise of Industry 4.0.*

Cooper, D., & Schindler, P. (2007). *Business Research methods* (8th ed.). new delhi: tata mcgraw hill.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative and mixed method approaches.* (2nd ed.). LA: Sage Publications.

Fehr, S. J. (2017). *Fehr, S. J. (2017). Emergency diesel-electric generator set maintenance and test periodicity.* Old Dominion University.

Filippo, E. B. (1984). *Personnel Management* (6th Edition). McGrow Hill.

Gelb, A., Meyer, C., Ramachandran, V., & Wadhwa, D. (2017). Can Africa be a manufacturing destination? Labor costs in comparative perspective. *Center for Global Development Working Paper*, 466.

Golub, S., Ceglowski, J., Mbaye, A., & Prasad, V. (2018). Can Africa compete with China in manufacturing? The role of relative unit labour costs. *The World Economy*, 41(6), 1508–1528.

Gong, Q., & Shang, Z. (2018). Rigidity and performance threshold: How routinization process affects dynamic capabilities. *African Journal of Business Management*, 12(7), 161-171.

Grubic, T., & Jennions, I. (2018). Remote monitoring technology and servitised strategies – factors characterising the organisational application. *International Journal of Production Research*, *56*(6), 2133–2149. https://doi.org/10.1080/00207543.2017.1332791

Hendarmin, H., & Kartika, M. (2019). The relationship between human capital and the regional economy productivity. *JEJAK: Jurnal Ekonomi Dan Kebijakan,* 12(1), 138-152.

Heshmati, A., & Rashidghalam, M. (2016). *Labour productivity in Kenyan manufacturing and service industries.*

Huebsch, R. (2019). *Revenue to Compensation Ratio*. https://smallbusiness.chron.com/revenue-compensation-ratio-36537.html

Irawan, C. A., Ouelhadj, D., Jones, D., Stalhane, M., & Sperstad, I. B. (2017). Optimisation of maintenance routing and scheduling for offshore wind farms. ,. *European Journal of Operational Research*, 256(1), 76-89.

J. Pöppelbuß, R. Plattfaut, K. Ortbach, A. Malsbender, M. Voigt, B. Niehaves, & J. Becker. (2011). Service innovation capability: Proposing a new framework. *2011 Federated Conference on Computer Science and Information Systems (FedCSIS)*, 545–551.

Jain, R., Gupta, D. S., Meena, M. L., & Dangayach, G. (2016). Optimization of Labour Productivity using Work Measurement Techniques. *International Journal of Productivity and Quality Management*, *19*, 485–510. https://doi.org/10.1504/IJPQM.2016.10000353

Karibasamma, N., & Alur, P. (2018). Contract Labour System In India: Issues and Challenges Need For Social Work Intervention. *Journal Global Values*, 9(2).

Kazaz, A., Manisali, E., & Ulubeyli, S. (2008). Effect of basic motivational factors on construction workforce productivity in turkey. *Journal of Civil Engineering and Management*, *14*(2), 95–106. https://doi.org/10.3846/1392-3730.2008.14.4

Kingori, A. (2013). *STRATEGIC OUTSOURCING AT AIRTEL KENYA*.

Koochaki, J., Bokhorst, J. A. C., Wortmann, H., & Klingenberg, W. (2013). The influence of condition-based maintenance on workforce planning and maintenance scheduling. *International Journal of Production Research*, *51*(8), 2339–2351. https://doi.org/10.1080/00207543.2012.737944

Kulkarni, P. P. (2013). A literature review on training & development and quality of work life. ,. *Researchers World*, 4(2), 136.

Kupzig, N. (2020). *Kupzig, N. (2020). The Effect of Generator Ownership on Firm Productivity during Power Outages in East Africa*.

Laudon, K., & Laudon, J. (2020). *Management Information Systems* (6th ed.). Pearson Education, Limited.

Li, H., Cipriano, S., Andrea, F., Gonzalez, T., Shelen, J., Marquez, C., & Mejia, C. (2019). *Optimizing the Labor Strategy of a Professional Service Firm*. https://doi.org/10.1109/TEM.2018.2836960

Loehlein, T. (2007). *Maintenance is one key to diesel generator set reliability*.

Madziga, M., Rahil, A., & Mansoor, R. (2018). Comparison between Three Off-Grid Hybrid Systems (Solar Photovoltaic, Diesel Generator and Battery Storage System) for Electrification for Gwakwani Village, South Africa. *Environments*, *5*(5). https://doi.org/10.3390/environments5050057

Marginson, S. (2019). Limitations of human capital theory. *Studies in Higher Education*, *44*(2), 287–301. https://doi.org/10.1080/03075079.2017.1359823

Mohamed, A. (2019). *FAULT DIAGNOSIS OF MECHANICAL SYSTEMS BASED ON ELECTRICAL SUPPLY CHARACTERISTICS* [Iniversity of Huddersfield]. http://eprints.hud.ac.uk/id/eprint/34927/1/Assaeh%20THESIS.pdf

Moussavi, S., Mahdjoub, M., & Grunder, O. (2016). Reducing production cycle time by ergonomic workforce scheduling. *IFAC-PapersOnLine*, 49(12), 419-424.

Mugenda, A., G., & Mugenda, A., G. (2012). *Research methods dictionary. Nairobi, Kenya: Applied Research & Training Services*.

Mwangi, K. (2014). *MAINTENANCE MANAGEMENT PRACTICES AND OPERATIONAL PERFORMANCE IN ELECTRICITY PRODUCING STATIONS IN KENYA*.

Nachmias, C., & Nachmias, D. (2008). *Research methods in the social sciences. New York:* Worth Publishers.

Nassazi, A. (2013). *EFFECTS OF TRAINING ON EMPLOYEE PERFORMANCE.: Evidence from Uganda.*

Nemeth, J. (2017). Human capital theory in the framework of organization theory. *Strategic Management*, 22(3), 29–35.

Nwankwo, D. (2018). *Methods & Effects of Manpower Training & Development on Organizational Performance: A Study of Selected Firms in Idemili North Local Government. Anambra State Nigeria.*

Oh, S. C. (2010). *Manpower planning and cycle-time reduction of a labor-intensive assembly line.* Massachusetts Institute of Technology.

Owusu, P., & Asumadu-Sarkodie, S. (2016). *Owusu, P. A., & Asumadu-Sarkodie, S. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation.* Cogent Engineering.

Pattichis, A. (2016). *Telematics in the Second Machine Age: Designing a Novel Business Model for Repair and Maintenance of the Connected Car*.

Punch, K. F., & Oancea, A. (2014). *Introduction to research methods in education.* (2nd ed.). Sage.

Salas, E., SI., T., K, K., & KA., S.-J. (2012). *The Science of Training and Development in Organizations: What Matters in Practice*. https://doi.org/10.1177/1529100612436661

Sapri, M., & Pitt, M. (2005). *PERFORMANCE MEASUREMENT IN FACILITIES MANAGEMENT; STATE OF KNOWLEDGE*.

Saunders, M., Lewis, P., & Thornhill, A. (2019). Understanding research philosophies and approaches. *Research Methods for Business Students*, *8*, 106–135.

Schmitz, C., Bartsch, S., & Meyer, A. (2016). Schmitz, C., Bartsch, S., & Meyer, A. (2016). Mobile app usage and its implications for service management–empirical findings from German public transport. *Procedia-Social and Behavioral Sciences*, 224, 230–237.

Schulz, E., Chowdhury, S., & Van de Voort, D. (2013). Firm productivity moderated link between human capital and compensation: The significance of task-specific human capital. , . *Human Resource Management*, 52(3), 423–439.

Sechilariu, M., & Locment, F. (2016). Sechilariu, M., & Locment, F. (2016). Urban DC microgrid: Intelligent control and power flow optimization. *Butterworth-Heinemann.*

Sejkorova, M., Hurtova, I., Glos, J., & Porkony, J. (2017). *DEFINITION OF A MOTOR OIL CHANGE INTERVAL FOR HIGH‐VOLUME DIESEL ENGINES BASED ON ITS CURRENT CHARACTERISTICS ASSESSMENT*.

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach.* . John Wiley & Sons.

Senra, P., Lopez, I., & Oliveira, J. (2017). *Supporting maintenance scheduling: A case study. Procedia Manufacturing,*. 11, 2123-2130.

Simeunović, N., Kamenko, I., Bugarski, V., Jovanović, M., & Lalić, B. (2017). Improving workforce scheduling using artificial neural networks model. Advances in Production Engineering & Management, 12(4), 337-352. *Advances in Production Engineering & Management*, 12(4), 337–352.

Starkey, A., Hagras, H., Shakya, S., & Owusu, G. (2016). A multi-objective genetic type-2 fuzzy logic based system for mobile field workforce area optimization. . *Information Sciences*, 329, 390–411.

Strutynska, I., Kozbur, G., Dmytrotsa, L., Sorokivska, O., & Melnyk, L. (2019). *Influence of Digital Technology on Roadmap Development for Digital Business Transformation*. https://doi.org/10.1109/ACITT.2019.8780056

Sweetland, S. (1996). Human capital theory: Foundations of a field of inquiry. *Review of Educational Research*, 66(3), 341-359.

Teece, D. J. (2019). A capability theory of the firm: An economics and (Strategic) management perspective. *New Zealand Economic Papers*, *53*(1), 1–43. https://doi.org/10.1080/00779954.2017.1371208

Teece, Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.

Turan, H. H., Kosanoglu, F., & Atmis, M. (2020). A multi-skilled workforce optimisation in maintenance logistics networks by multi-thread simulated annealing algorithms. *International Journal of Production Research*, 1–23. https://doi.org/10.1080/00207543.2020.1735665

UNDP. (2021). *Goal 8: Decent work and economic growth*. https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-8-decent-work-and-economic-growth.html

United Nations Economic commission for Europe. (2013). *Compilation of Good Practices in Statistical Offices*. https://www.unece.org/fileadmin/DAM/stats/publications/HRMT_w_cover_resized.pdf

Voessing, M., & Kunze von Bischhoffshausen, J. (2018). *Field Service Technician Management 4.0*.

Vossing, M. (2017). *Towards Managing Complexity and Uncertainty in Field Service Technician Planning*. *01*. https://www.researchgate.net/publication/319224644_Towards_Managing_Complexity_and_Uncertainty_in_Field_Service_Technician_Planning/link/5ada1fd7458515c60f5bd325/download

Wilden, R., Gudergan, S. P., Nielsen, B. B., & Lings, I. (2013). Dynamic Capabilities and Performance: Strategy, Structure and Environment. *PLS Applications in Strategic Management: Partial Least Squares Modeling in Strategy Research*, *46*(1), 72–96. https://doi.org/10.1016/j.lrp.2012.12.001

Winter, S. (2003). Understanding dynamic capabilities. *Strategic Management Journal.*, 24(10), 991–995.

Yumbe, Y., & Norihisa, K. (2019). *Workforce Scheduling System to Manage Static Optimization and Dynamic Re-optimization for Field Service.*

Zahra, S., Sapienza, H., & Davidson, P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. *Journal of Management Studies*, 43(4), 917-955.

Zhe, L. (2010). Research on pay equity and organization efficiency of compensation administration. *International Conference on Education and Management Technology*, 622-625. https://doi.org/10.1109/ICEMT.2010.5657578

Zhou, S., Zhou, A., Feng, J., & Jiang, S. (2019). Dynamic capabilities and organizational performance: The mediating role of innovation. *Journal of Management & Organization.*

Zikos, S., Rogotis, S., Krinidis, S., Ioannidis, D., & Tdzovaras, D. (2016). Human-Resources Optimisation & Re-Adaptation Modelling in Enterprises. *Information Technology Institute/Center for Research & Technology Hellas, Thermi-Thesalonoiki, Greece*.

APPENDICES

Appendix I Questionnaire

Greetings. My name is Erick, a Master's student at Strathmore University pursuing a degree in Business Administration. I request that you kindly assist in providing the information required in this form to better understand the different factors enhancing labor optimization in diesel generator service businesses. The information will be confidential and will be used only for research purposes. The faculty supervisor for this project is Dr Joseph Onyango. Your participation in this study is voluntary. You can choose not to participate or answer any question in the study at any time. All your responses will be kept confidential. This means that what the data will only be used for the purposes of this research. The information in this form will also not identify you as the respondent. All records pertaining to this study will be securely stored. If you would like to contact me even after this interview for any reason, you can reach me on telephone number 0722678070. You may also contact the School of Business Studies at Strathmore University on Telephone 0703034414. The results of this study which will be available in the Strathmore Business School repository is aimed at assisting business leaders, service managers, scholars and policy makers with vital information on labor optimization.

PART A: Demographics and Respondents Profile

1. What is your level of employment in the organisation (Tick as appropriate)?

Senior management [ ] Middle management [ ] Other Staff [ ]

Engineer [ ]

2. Indicate your gender.
    a) Male [ ]
    b) Female [ ]
3. What is your highest academic qualification? (Tick as appropriate).

a) Certificate [ ]

b) Diploma [ ]

c) Bachelor's degree [ ]

d) Master's Degree [ ]

e) Others specify_____

4. Kindly indicate your age bracket. (Tick as appropriate)

a) 21-30 [ ]

b) 31-40 [ ]

c) 41 to 50 [ ]

d) Over 50 years [ ]

5. For how long have you been with the organisation. (Tick as appropriate).

a) Less than 2 year [ ]

b) 2-6 years [ ]

c) 7-10 years [ ]

d) Above 10 years [ ]

6. For how many hours is an engineer required to work in a day.

a) Less than 5 hours [ ]

b) 5-8 hours [ ]

c) Above 8 hours [ ]

Section B: Perceived factors that affect labour optimisation in the diesel generator service business in Kenya

7. Kindly indicate the extent to which you agree on the following statements with regards to scheduling and its role in labour optimisation in diesel generator service business. Use a scale of 1-5 where 1 Least extent, 2 Low extent, 3 Moderate extent, 4 High extent, 5 Great extent.

	Scheduling on labour optimisation	1	2	3	4	5
a	My organisation plans and schedules generator service jobs in advance.					
b	Scheduled jobs in my organisation are often interrupted by adhoc jobs that need to be given priority on the schedule.					

c	In my organisation the scheduling process of service engineers considers traffic jam to optimise engineer labour.					
d	My organisation uses non-static scheduling to help optimise engineer labour in order to overcome obstacles that arise.					
e	Engineer Scheduling in our organisation is based on a schedule that does not change.					
f	Engineer Scheduling in our organisation is based on priority jobs.					
g	Scheduling in our organisation is based on the situation and both priority and strict schedules are used appropriately.					
h	In our organisation scheduling ensures 100% billing of required work hours per day.					

8. Kindly indicate the extent to which you agree on the following statements with regards to engineer training and its role in labour optimisation in diesel generator service business. Use a scale of 1-5 where 1 Least extent, 2 Low, 3 Moderate extent, 4 High extent, 5 Great extent.

	Training on labour optimisation	1	2	3	4	5
a	Engineer training in my organization is offered to improve skills and optimise labor.					
b	Trained engineers in my organisation take a shorter time on service and repair of gensets compared to untrained engineers.					
c	Untrained engineers contribute to most of the repeat service jobs.					
d	Quick Job turnaround in my organisation is mainly contributed by trained engineers.					

e	Engineers in our organization are trained on the equipment they service.	
f	By training all engineers, the organisation is able to optimise labor of all engineers.	
g	In our organisation trained engineers bill 100% of their required work hours in a day.	

9. Kindly indicate the extent to which you agree on the following statements with regards to labor optimisation in diesel generator service business in your organisation. Use a scale of 1-5 where 1 Least extent, 2 Low extent, 3 Moderate extent, 4 High extent, 5 Great extent.

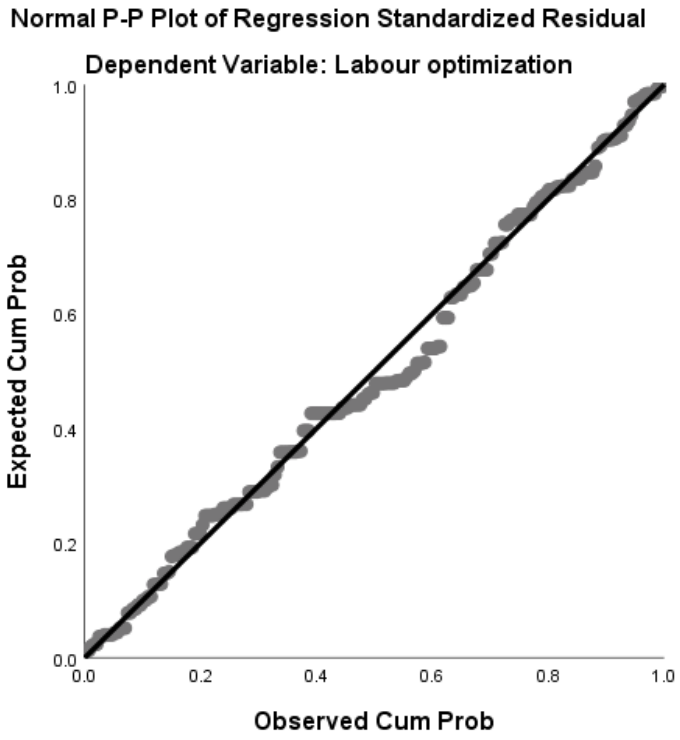
	Technology and Labor Optimisation	1	2	3	4	5
a	Technology is applied in the entire diesel generator service process					
b	In my organisation technology is used in the service job planning.					
b	My organisation uses technology to measure the efficiency of the service event.					
c	My organisation technology enables engineers to complete service work on a generator as planned.					
d	In my organisation technology enables us to detect engineer idle time.					
e	The overall use of technology in our service organisation contributes to labor optimisation.					
f	In our organisation technology ensures we bill 100% of the engineer daily work hours.					

10. Kindly indicate the extent to which you agree on the following statements with regards to the impact to overall labor optimization in diesel generator service business. Use a scale of 1-5 where 1 Least extent, 2 Low extent, 3 Moderate extent, 4 High extent, 5 Great extent.

	Labor Optimisation	1	2	3	4	5
a	In my organisation labor optimisation in diesel generator service business is important.					
b	My organisation uses labor optimisation to calculate the total number of engineers required.					
c	In our organisation recovery of 100% of the engineer labor hours is significantly dependent on the engineer training.					
d	Recovery of 100% of our engineer labor hours is greatly dependent on the manager scheduling techniques					
e	Our organisations recovery of 100% of the available engineer labor hours is to a great extent dependent on technology.					

----------Thank you for your participation----------

Appendix II Linearity



Normal P-P Plot of regression standardized residual

Appendix III Ethical Clearance

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 340156

Date of Issue: 18/March/2021

RESEARCH LICENSE

This is to Certify that Mr.. Erick Zablon Sangoro Ouma of Strathmore University, has been licensed to conduct research in Kisumu, Mombasa, Nairobi, Nakuru on the topic: OPTIMIZED LABOR AS AN OPERATIONAL MODEL IN DIESEL GENERATOR SERVICE BUSINESS IN THE KENYA COMMERCIAL INDUSTRY for the period ending : 18/March/2022.

License No: NACOSTI/P/21/9395

340156

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix IV Strathmore Business School Approval

Ole Sangale Rd, Madaraka Estate,
P.O Box 59857 00200, Nairobi, Kenya.
Cell: +254 703 414 6/7, Twitter: @StrathMBA
Email: info@sbs.ac.ke or visit www.sbs.strathmore.edu

Strathmore UNIVERSITY
BUSINESS SCHOOL

3rd March 2021

To Whom It May Concern.

Dear Sir/ Madam,

RE: FACILITATION OF RESEARCH – ERICK ZABRON SANGORO OUMA

This is to introduce Erick Ouma who is a Master of Business Administration student at Strathmore University Business School, admission number MBA/120902/19. As part of our MBA Program, Erick is expected to do applied research and undertake a project. This is in partial fulfilment of the requirements of the MBA course. To this effect, he would like to request for appropriate data from your organization.

Erick is undertaking a research paper on **"Optimized Labor as an Operational Model in Diesel Generator Service Business in the Kenya Commercial Industry".** The information obtained from your organization shall be treated confidentially and shall be used for academic purposes only.

Our MBA seeks to establish links with industry, and one of these ways is by directing our research to areas that would be of direct use to industry. We would be glad to share our findings with you after the research, and we trust that you will find them of great interest and of practical value to your organization.

We appreciate your support and shall be willing to provide any further information if required.

Yours sincerely,

Caroline Tiara.
Manager – MBA Programs.
Strathmore University Business School.